ENGINEERING NEWS

THE experiments of the Pennsylvania R. R. Co. with heavy English steel rails and supports, to compare them with American rails and road-bed, will be carried on with 2 miles of these rails laid in half-mile sections. On the New York division the rails will be laid between Menlo Park and Metuchen; on the Philadelphia division, between Lemon Place and Kintzer's; on the Middle division, one mile east of Huntingdon, and on the Pittsburg division, the rails will be put down on the eastern slope of the Alleghenies, near Allegrippas. The new rail will weigh 90 lbs. to the yard, and they are to be tested for 10 years. It is also reported that the company has ordered an English engine, of the usual type, for comparison with the American locomotive.

THE Harlem Railroad is showing more than usual foresight and liberality in proposing to sink its tracks at its own expense for the seven miles through the city limits from the Harlem river to the Yonkers line, at an estimated cost of $3,500,000, which ought to suffice to do the work very well now, although it will cost much more to do the same work after the "annexed district" has settled up more densely. It seems likely that work will begin soon. The same kind of work is needed and ought to be required at dozens of our large cities, as notably at Chicago, where the innumerable grade-crossings are a very dangerous nuisance, and are said to result in the loss of 200 to 250 lives per annum. A very few million dollars would remove the nuisance completely and forever, and it will not be creditable to the good sense or the humanity of Chicago if it is long delayed.

THE New England Railroad Club held a very successful banquet in Boston on Sept. 14, presided over by Mr. J. N. LAUDER, the feature of the evening being an address by Mr. J. R. COLEMAN, of Providence, who, after justly calling attention to the fact that all the essential features of the modern locomotive were either invented or improved by STEPHENSON, and that his locomotives made good time compared with those of the present day, and commenting on the enormous growth of traffic by adducing that tonnage carried has grown from 100,000,000 in 1871, to 482,000,000 in 1886, (which understates the fact by taking no account of the great increase in average haul) added these words of wisdom:

"The tonnage has increased 2¼ per cent. faster than the population. You must meet the demands of the tremendous business that you will be forced to do by immensely heavier bridges and rails to stand the immensely heavier traffic. You must change the construction of your freight cars. The percentage of cost for repairs on the freight cars that trundle along at ten miles an hour is greater than on the most expensive passenger coach. Expensive cars will be cheaper in the end.

"You will find that things that cost the most to begin with are the cheapest in the end. You must not only transport passengers, but transport them safely. A few thousands saved on signals sometimes costs a half million in damages; a false economy in the way of heating may cost even more."

THE Michigan Central is building a large lot of exceptionally fine box cars, of 50,000 lbs. nominal and 60,000 lbs. real capacity, 35 ft. long. They have the Hewitt spark-proof flush door, the Ames automatic link coupler (which is to be regretted, although it is better than none), and many improvements of detail, especially in the trucks.

AN accident which gave unmistakable confirmation of the views we expressed as to the dangerous and absurd character of the plans proposed last summer for the Brooklyn bridge transit, happened on Friday last near midnight.

The 11.20 train from Brooklyn had unloaded its passengers at the New York end and was being switched over to the return track when the hind truck of the first car refused to take the switch. This resulted in turning the car lengthwise across the track, obstructing travel for some time. The only damage done was the breaking of the iron fence along the walk, leading to the cars and the destruction of the front platform of one of the cars, but what might have happened had a similar derailment occurred in the face of an approaching train, and still more, with the derailed train attached to a cable moving at 10 miles per hour, is not a pleasant subject to contemplate.

THE Board of Experts to consider the report of the Committee on Terminal Facilities of the Brooklyn bridge trustees has been appointed, and consists of Col. F. K. HAIN, General Manager of the Manhattan Elevated Railway, Col. JULIUS W. ADAMS, of Brooklyn, Consulting Engineer, and Mr. JOSEPH CRAWFORD, Supt. of the New York Division of the Pennsylvania Railroad. The precise extent of the authority given to this Board, and the exact nature of the committee report which is to be laid before them, have not yet been made public. The composition of the Board is such as to inspire confidence, however, that every phase of the great question submitted to them will be duly and carefully considered before any final recommendations are made.

The meeting of the Board of Trustees at which the original EMERY plan was reported by the present committee, and its immediate construction authorized, was held on May 18 last. The discussions of this journal, which were followed by the prompt withdrawal of this authority, appeared June 4-11. The committee were then instructed to prepare further and more detailed reports for the consideration of the Board. As they have now occupied something over three months in the preparation, we may well believe that it will be of a more careful and defensible nature than was the last, and we sincerely hope it will be such as to merit general approval, and vindicate the wisdom of the Board in permitting such unusual delay for the preparation of a "try, try again" report. Should it prove so, the fact will be recognized nowhere more fully and cordially than in this journal.

ON Tuesday of this week Lieut. ZALINSKI demonstrated, before Secretary WHITNEY and a number of army and navy officers and foreign military attachés, that it was possible to project a dynamite shell a distance of one mile by means of compressed air and to most effectually destroy a large schooner set aside by the Government for this test. Two trial shots with empty shells were first fired to obtain the range and then with an air-pressure of 607 lbs. to the square inch a shell charged with 55 lbs. of nitro-gelatine was discharged. This first shot exploded in the water a few yards from the schooner and the concussion alone crushed in the woodwork on her quarter and set her to leaking. A second shot exploded fairly under the stern of the schooner and made a total wreck of the vessel. The test was very satisfactory and the accuracy of the gun was remarkable.

WORK has begun in earnest on the new iron railroad bridge over the Connecticut river at Hartford. The sides and roof of the old structure have been mostly torn off, a derrick is in position at the east end of the bridge, a pile driver and several scows are anchored in the river on the lower side of the bridge at the east end and a large gang of men are at work on the heavy timbers to be used in the demolition of the old bridge and the construction of the new one. The new bridge is not to be a double track one in the proper sense of the word, as at first stated, but the two tracks will run close together as now, as a gauntlet.

THE fight on the part of certain property owners on Fifth Ave., Brooklyn, to prevent the erection of the elevated road running south to Greenwood cemetery, has ended in favor of the company. The effect of this will be the immediate continuation of the work on the road. At Twentieth St. a tunnel is to be constructed to Ninth Ave., under the high hill on which Prospect park lies, connecting the elevated with the Prospect park & Coney Island Railroad. This will open up a new and speedy all-rail route between the City Hall, New York and Coney Island, *via* the Brooklyn bridge, and tend to still further increase the traffic over that structure.

A TEST was made recently at the Boston & Providence repair shops of the "Davis safety truck appliances," which is designed to prevent a truck slewing when derailed. It consists of substantial iron rods running from the end of the truck to the floor timbers near the center of the car, and so fastened as to allow for the legitimate swing of the trucks in running round a curve, but of no more. At the trial a 24-ft. rail was removed on a curve, and a passenger car was sent over it a speed of 20 miles per hour. Both trucks kept quite parallel with the rails, and were uninjured. The device is one of a very promising nature, and we believe, if introduced, would have great influence to decrease the number and disastrousness of derailments.

THE manufacture of steel sleepers is said to promise to be quite an important industry in Great Britain. One East Indian company has ordered 27,000 tons, another line has ordered 280,000 ties, and other companies are alleged to be now negotiating.

THE cost of the great bridge which the Illinois Central Railroad Company has undertaken to build across the Ohio river at Cairo, Ill., according to a newspaper report, is estimated at $3,000,000. More than three years will be required for its completion. It is understood, so far as the plans have been developed, that the bridge will be entirely of steel, and will rest on piers of solid masonry about 175 ft. high. There will be three spans of 500 ft. or more. The question of fixed span or draw has not been determined. The length of the bridge will be about 5,000 ft., and there will be an equal length of iron or steel approaches ascending at a grade of about 40 ft. to the mile to the level of the bridge. But a single track will be provided for. The peculiar difficulties of the enterprise arises in great measure from the nature of the approaches to the stream, which are through low bottoms on both sides of the river; but it is believed that all the obstacles to the work will be successfully met.

THE latest advices from the Argentine Republic indicates that that enterprising country is losing its head a little.

A large number of new railway projects are being submitted to Congress. Within 15 days the fresh schemes involved the construction of 4,000 miles, all, with two exceptions, involving Government guarantees of 5 or 6 per cent. interest on the cost of construction. The exceptions are an extension of the Rosario line to Tucuman, which the Rosario Company proposed to carry out without assistance from the State, and a branch line which the Central Argentine Company seek to construct. Congress has also taken up a large steamship subsidy project. Railway construction has been for some time very active there, and there can be little doubt that they are overdoing it.

Gen. LOUIS FITZGERALD, THOMAS C. CLARKE, STEVENSON TOWLE, JAMES B. SMITH, and GEORGE L. RIVES, Commissioners of Rapid Transit, in their report to Mayor HEWITT, which has been made public this week, came to the following conclusions; almost precisely identical with those which have been often expressed by this journal.

You will see that it is evident that nothing can be done to give the city further rapid transit until the Legislature sees fit to remove, in whole or in part, such prohibitions as now exist. * * * The growth of the city is so rapid that even now the elevated roads can no longer carry comfortably the number of passengers. The remedy seems to us to be a railroad from Forty-second street to Wall street or South Ferry, to be extended northward as travel demands. Such a road, to be of service, should be as central and direct as possible and the trains run at a speed of at least 25 miles per hour. We are led to the conclusion that there is but one way to obtain such rapid transit, and that is by the construction of a solid viaduct line through the blocks, as far as possible, and when compelled to cross or follow the lines of streets to be constructed with much greater strength and solidity than the present elevated railroads. Such a viaduct should be built in accordance with the following conditions:

"*First.*—The structure should be built through the blocks, of brick and stone, and in the most solid manner. The streets should be crossed by massive steel girders, with solid steel floors, having no openings. The tracks should consist of heavy steel rails on ties laid in an elastic material between floor and ties. There would be no jar or break of continuity of motion in such a structure, and trains could be run at high speed with little noise.

"*Second.*—The stations should be not less than one-half mile apart, and long enough for 10 cars. The cars should be as wide as possible.

"*Third.*—Trains should be run by independent mo-

tors and as frequently as on the elevated roads, and at a speed of at least 25 miles per hour, including stops. This would enable the trip to be made from Wall street to City Hall, one half-mile, in one and one-quarter to one and one-half minutes; Union square, two miles, in five to six minutes; Madison square, two and one-half miles, in six to seven minutes; Forty-second street, three and one-half miles, in nine to ten minutes."

The Commission also state that they have made sufficient examination to convince them that a viaduct line, such as described, can be laid out and built for a sum upon which capital might reasonably be sure of returns and one constantly increasing in amount. They do not specificially recommend a high viaduct, with spans of the average lengths of a block so that a single pier might be placed, for the most part, midway between the street lines, but that is the evident tendency of their recommendations.

THERE have been more heavy rains in western Texas since our last report and a bridge on the Denver Texas & Gulf near Wichita Falls was carried away. There were also washouts on the Galveston, Harrisburg & San Antonio, one of which wrecked a freight train. Other washouts on the Louisville & Nashville and the Savannah & Tybee were caused by heavy gales at high tide. There have been no train accidents this week from bridge failures.

THE worst accident reported this week was a head collision on the Chicago, Milwaukee & St. Paul two miles north of Dubuque, Ia. A brakeman and the engineers and firemen of both engines were killed and three other trainmen were seriously injured. The passengers escaped with slight bruises. The train running north was in two sections, and the accident was due to a confusion of the train dispatcher's orders. Two other serious freight wrecks, one on the Pittsburg, Fort Wayne & Chicago, 20 miles east of Lima, O., and one on the Pennsylvania near Wilkesbarre, Pa., were made still more horrible by the burning of oil cars and the explosion of dynamite.

THE remarkably creditable accident record of the English railways, which began to give evidence of a permanent and great improvement in the past decade, has been broken by a single accident in which many more lives were lost than in the two preceding years, or 23 in all, with 60 injured. It was a crossing collision of two excursion trains, illustrating for the thousandth time that it is at least a hundred times as dangerous to travel by excursions as by regular trains. The accident is stated to have been caused by "defective signaling," or by running past a signal, and its immediate cause was that the head train had stopped according to the English fashion, which seems to us so strange, "while the tickets were being collected," and *had stopped directly over a crossing track*, which was horribly bad railroading. The accident deserves more attentio nthan we can give it this week.

A disastrous collision also occurred on a branch of the Pennsylvania road on Sept. 19 due to a cause very similar to the apparent cause of the English accident, wrong block signals, and there have been a number of other such occurrences on the Pennsylvania, which seem to us to throw grave doubt on the practical value of the block system as managed by independent operators in successive signal boxes. The Pennsylvania showed great enterprise in borrowing this costly safeguard from English practice ahead of all other roads in this country, and it is probably much safer on the whole than the ordinary dispatching system. But in trusting to the intelligence and watchfulness of numerous cheap men to follow a certain dull routine correctly, it introduces new dangers as well as removes old ones. An entirely trustworthy automatic block system is the deal one, and to that complection we must come at last.

CRUDE oil is being applied as a fuel in brick-making by Messrs. P. L. SWORD & SON, of Cleveland, O. The arches in the kiln, which holds 250,000 bricks are heated by 24 burners. The oil-flow is met at the point of ignition by a steam-blast which sprays it. Instead of 7 days heating, as with wood or coal, 4 days burning with oil produces a better product. One man attends to regulating the oil-flow where three stokers were formerly required. While the present plant is an experiment, the proprietors are said to consider it cheap enough to introduce for permanent use.

Coal Delivery to Locomotives.

[Report of the Committee of the Master Mechanics' Association on "Coaling up Locomotives—The Various Plans in Use and their Relative Cost and Efficiency," read by Mr. J. D. BARNETT, Chairman.]

The replies received to circular issued by your Committee show that the more common modes of delivering soft coal to tender are: First, by shoveling direct from car to tender; second, by bucket and crane, and by small tipping or dump cars (both at a level of tender coping), and third, by chutes at high elevation.

Shovel and Platform. The cost of shoveling direct from car to tender, and part of the time from car to platform, and from platform to tender varies (in one case reported) from 25 to 34 cts. per ton, where the output is but from 42 to 55 tons per week, delivered over a period of sixteen hours in each of the six working days. This large cost is due to the exposure of the men to the rigors of a Canadian winter, also to the fact that the fuel is often frozen fast into the cars, and to the men not being fully employed. The rate of pay is 12 cts. per hour. A maximum rate of delivery is 3 tons per hour per man, but this speed is not maintained, the lifting by shovel of twenty long tons per ten hours being considered a fair days' work (at medium temperature) for one man on day wages.

Mr. F. J. BROWNELL (B. & L. Ry.) shovels from platform at level of footplate, delivering 30 tons per day; the cost of labor measuring and delivering, averages 10 cts. per ton. We infer that this amount does not include cost of delivering on to platform.

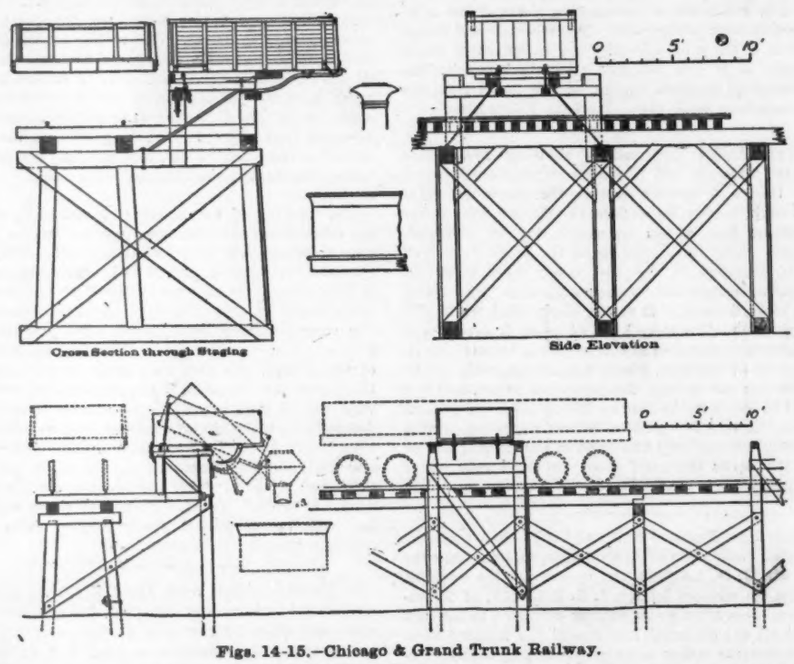
The Roadmasters' Association, we find, made a report on "handling coal" for locomotives in 1885, in which they state that of the replies received, giving the cost of hauling coal over platforms of different constructions, the maximum was 30, the minimum 11, and the average 19.4 cts. per ton.

Crane and Buckets. For delivery by bucket and swing-jib crane, from the platform between coal cars and delivery track, little improvement is obtainable, although it is the most common practice in Great Britain and her colonies. An average of the time occupied in fully coaling up one tender is from five to ten minutes; the crane being worked by manual labor, its small buckets (stored on the platform) having been previously filled from the cars by shovels.

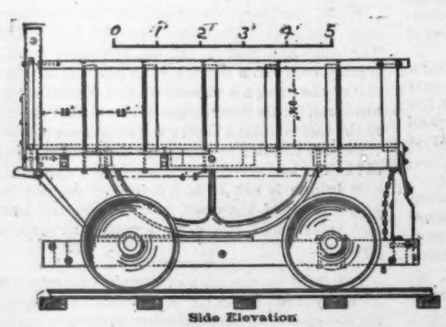
Mr. J. MCGRAYEL (D., M. & F. D. Ry.) reports that with half-ton buckets two men handle 25 tons per day, at a cost of fifteen cts. per ton. Thus these men shovel and then lift by crane 12½ per tons as a days work, receiving as wages $1.87½ per day.

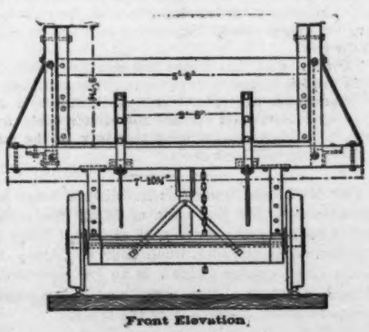
Mr. J. MACKENZIE (N. Y., C. & St. L. Ry.) reports an average taken from two stations, showing the cost by crane to be 7½ cts. per ton, the rate of pay being 12½ cts. per hour, and the rate of delivery 55 tons per day, each man shoveling and then lifting 18 tons per day.

Dump Cars.—Delivery by tipping pockets or dumps is shown by Figs. 14, 15, forwarded by Mr. H. ROBERTS, (C. G. T. Ry.) These dumps are fixtures, except that they can partially oscillate on a horizontal axis parallel with delivery track, therefore the coal cars have to be moved as they are being unloaded to suit the positions of the dumps, and storage *in situ* is practically *nil* except the coal is handled by shovel three times, hence, when the storage must be arranged for, a variation on this plan becomes necessary, and is reported in four cases. It is clearly shown (for the C. P. Ry.) by three photographs and Fig. 16, sent by Mr. W. H. STEARNS, illustrating a dump mounted upon a traveling carriage or trolly. He quotes a daily delivery of 45 tons, costing 14 cts. per ton the rate of pay for four men varying from 14½ cts. per hour to foreman at 18¾ cts. per hour. This gives a man's shoveling and trolleying capacity at 11¼ tons per day. To check the amount delivered a track scale



Figs. 14-15.—Chicago & Grand Trunk Railway.





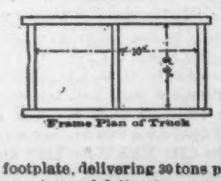


Fig. 16.—Dump Mounted on Traveling Trolly. Canadian Pacific Railway.

weighs the tender before and after taking its supply. The first cost of the low timber trestle shown averages $2.80 per foot run.

Mr. J. MACKENZIE uses a similar system, the dumps holding 6 tons and dipping to an angle of 45°, costing 8 cts. per ton, delivering 74 tons per day, rate of pay, 12½ cts. per hour. With two men on each shift of twelve hours the rate of pay would be $1.50, and each man would handle 18½ tons.

Mr. J. STRODE reports a similar apparatus in use at two points on one division of the N. C. Ry. He says:

"The platform and trestle system consists of a raised platform, 200 ft. long, parallel with the main track, 32 ft. wide and 10 ft. above top of rail. Upon this platform is arranged a system of delivery tracks spaced 25 ft. apart, at right angles to the main track and extending back the full depth of the platform.

"At a point 8¾ ft. from the center of the main track is a stop which serves the double purpose of first stopping the car at a given point, and secondly, of releasing the hook on the back end of truck: then the sudden impact of the truck dumps the coal into the tender.

"Upon this platform also rests a trestle 200 ft. long, with an average height of 8 ft. 11 ins., and a grade of 9 ins. per 100 ft. The approaching trestle is 447 ft long and has a grade of 3¾ per cent. The cars being placed upon the high trestle, the coal is loaded directly into the coal trucks beneath or dumped upon the platform. In using the platform stock coal, it has to be re-shoveled into the coal trucks.

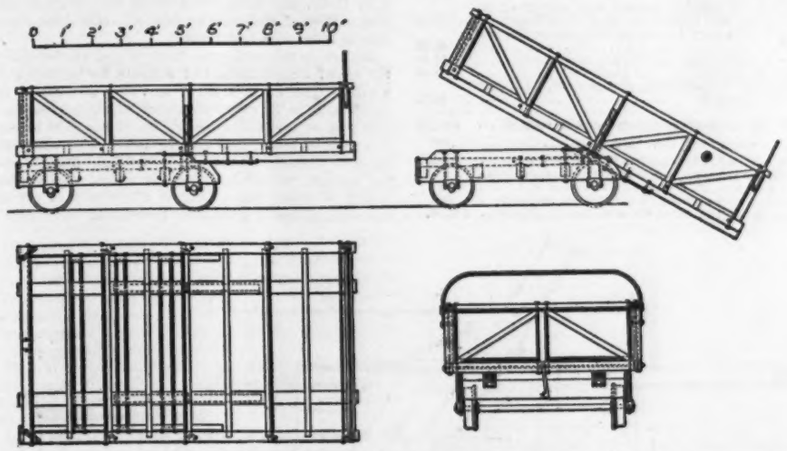


Fig. 17.—Northern Central Railway.

"The truck herein mentioned—a drawing of which accompanies this report (Fig. 17,)—is simply a dump car (with one truck) turning on its short axis. One end of the car is open and the truck is placed under the opposite end. The inside dimensions are 10 ft. 8 in., long by 5 ft. 10 ins. wide by 1 ft. 10 ins. high. This car, when loaded with 3 tons, is operated by one man. This system is preferred at stations along the main track for the reason that when the locomotive stops with its train at the point for coaling, the tender can be loaded in a few seconds. The average cost per ton for January, February and March, 1887, was 4.6 cts., employing two men and delivering 57⅞ tons per 24 hours. This gives an average of 28¾ tons per man."

In most cases of delivery by dumps known to your committee, advantage has been taken of a difference in land elevation, thus largely reducing the first cost of the plant, which (considering that it is a quick system of delivery) is not large in any case.

This plan fully worked out, can be made to suit the varying conditions of an irregular supply (where the coal is in part drawn from coal cars and in part from a storage heap) better and with less cost than most *compromise* schemes, and is shown by Fig. 18, in which track *A* is used for coal cars fresh from the mine, when their loads are to be delivered into dumps for immediate locomotive use; track *B*, within the storage shed, is for delivery from cars into the sheltered storage heap; and track *C*, if required, for delivering supplementary stock, in case the shed should not prove large enough to contain the amount to be stored at any exceptional season. If the shed be narrow, outside tracks *A C* only are needed for delivering stock to be stored.

It should be understood that the light rails for the trollies (running at right angles to the main tracks) are flush with and cross over all three tracks *A B C*, so as to permit trollies to be run back to supplementary stock *D*.

Chutes: The general and favorite mode of delivering, where large amounts of coal per day have to be handled, is by chutes.

The style of chute shown by Mr. W. H. HARRISON (B. & O. Ry.) on Fig. 19 is the most expensive in the first cost, especially where the land (required for the long approach) commands a high price, but it has the advantages of a reasonable amount of storage, is worked by steam or locomotive power, and delivers 115 tons per day at the low cost of 4⅞ cts. per ton, without (we infer) it being worked up to its capacity.

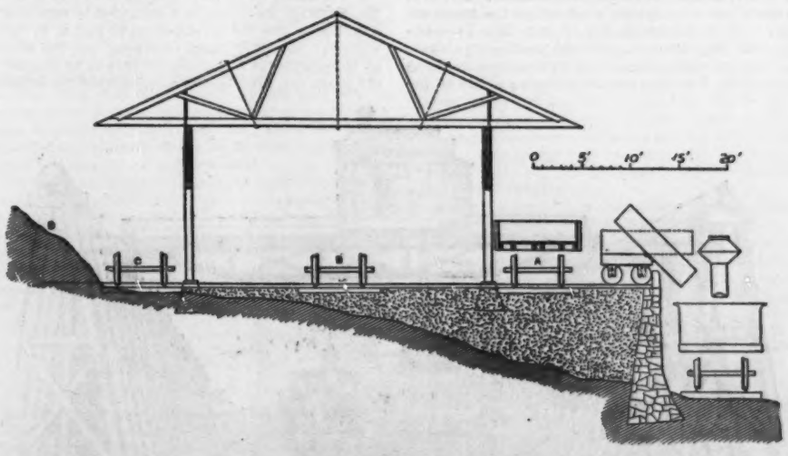


Fig. 18.—System for Mixed Coal Delivery.

The illustration shows a center high level track on open timber trestle, carrying drop-bottom cars delivering their coal on to a lower platform, on each side of which are the pockets so arranged that delivery can be made into tenders on both sides of the structure. The pockets are very deep, of quick pitch, and marked at the sides to indicate the weight of the contents at each given level. The aprons are of a much flatter pitch than the pockets.

The Kerr Chute, as used by Mr. J. MEEHAN (C. N. O. & T. P. Ry.), is shown by drawing Nos. 1, 2 and 3, as used by Mr. C. E. SMART (M. C. Ry.) by drawing No. 16, and drawing No. 6 gives the earlier practice of the C. M. & St. P. Ry. Mr. KERR informs us that his patent right has run out, but he will supply a full set of plans and detail drawings for $50. [None of these drawings are engraved, it being assumed that the Kerr chute is familiar to most concerned. ED.]

The Clifton chute is shown by Figs. 20 and 21, and is strongly indorsed by Mr. T. B. TWOMBLY (C. B. I. & P. Ry.) and also by Mr. C. LATIMER in his communication to the Roadmasters' Association in 1885.

The distinguishing characteristics of the Kerr and Clifton chutes are: First, the way in which the aprons are secured by latches or catches; second, the balancing of the aprons; and third, the use of a hinged or flap door to form the front of the pocket. The G. T. Ry. experience coincides with that of Mr. DON J. WHITTEMORE (C. M. & St. P. Ry.) that this latter feature flap front door) is not necessary, increasing both first cost and repairs.

However, the more recent device in some of the Clifton chutes, of an inside division or intermediate flap, permitting the contents of a large pocket—say six tons capacity—being delivered in definite proportions into two small tenders, appears to be a device worthy of note; also balancing the apron by a wooden lever is probably cheaper and less liable to breakage, or other failure than the use of chains, pulleys and balance weights, although nothing but extended experience will actually settle such questions.

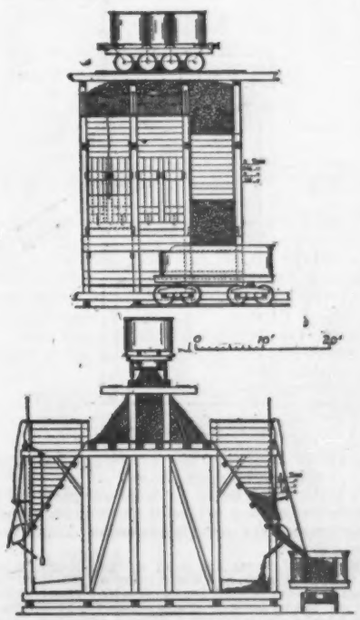


Fig. 19.—Baltimore & Ohio R. R.

In designing chutes, the angle for bottom of pocket and apron has always been a troublesome point to settle. A comparison of the various drawings shows the Meehan (Kerr) to drop 45° from the horizontal; the Clifton, 34°; the B. & O. G., 33°, but its apron only 27°; the Smart (Kerr), 33°; the C. M. & St. P. Ry., (Kerr), 30°; and their new style being 38°; and the G. T. Ry., 36°. The average—taken over the seven aprons—showing a dip of 36°.

The cost of labor for delivering coal by chutes is given by Mr. SMART at 7 cts per ton. Allowing for interest, depreciation, renewals and repairs at 20 per cent. per annum, on the first cost outlay of $4,000 for the chutes complete, the cost of delivery per ton will be increased almost 1¼ cts, or to a total of 8¾ cts per ton on an actual delivery of 175 tons per day. The first cost of his set of 40 chutes averages $100 per pocket. The cost, as given by Mr. MEEHAN (C. N. O. & T. P. Ry.), for delivery by chute, using drop-bottom cars and high trestle (somewhat similar to the B. & O.) in the slack season when a minimum of 18 tons per day is delivered, is 6 cts per ton, with labor at 10 cts. per hour. Allowing the customary 20 per cent. on a first cost of $5,500, and using only the minimum output, it would increase the cost of delivery by 16⅔ cts. per ton; but it should be borne in mind that the business in the cotton season far exceeds the average, and that the permanent works are adequate to deal with an expected permanent increase in business, so that they can readily handle 320 tons per day every day in the year (equals 116,800 tons per annum), which if divided into the 20 per cent. adds but 0.34 ct. per ton to the labor cost of delivery, and the labor cost would also be lessened.

It is probable that in a Southern climate the outlay for repairs and renewals to a wooden structure is far less than in the damp variable climate North and East; but the same figures for renewals and repairs have been here used to facilitate comparison.

Horse and Cart.—For delivery into chute-pocket by horse and cart—the coal to be shoveled from either car or storage heap—annual contracts are made at 10, 12½ and 15 cts. per ton; more than 100 tons per day being delivered when the price is as low as 10 cts. However, it comes directly under our notice that one man and horse can day by day handle 30 tons in less than 10 hours, receiving 7 cts. per ton; the ramp being of easy grade, of least possible height, and the haulage distance short.

Mr. ALLAN COOKE (C. & E. I. Ry.) describes a chute (probably the Kerr) which he is using at four coaling stations, delivering 200 tons per day, requiring seven men at 12½ cts. per hour to handle, making the average cost per ton to deliver 3.78 cts. to which must be added

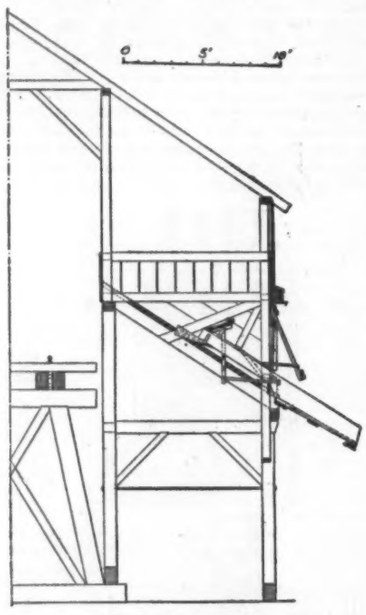


Fig. 21.—Clifton Chute.

1¼ cts. (or say in all 5 cts.) for "interest, etc.," at 20 per cent. on a first cost for plant of $5,031.

This is the lowest figure for chute delivery given in any reply we have received, but it comes no where near the low figures given in the Roadmasters' Committee's report, who say.

"Where coal chutes are used we find a maximum price per ton of 9 cts. and a minimum of .045, (with) an average of .074 cts. per ton, (showing) an average (saving) 12 cts. per ton in favor of chutes. The time consumed in taking coal from chutes, 1 minute, and from other devices 12 minutes, showing a saving in time of 11 minutes for each engine coaled in favor of chutes, and where 3,000 tons of coal is handled monthly, we find a saving in favor of coal chutes of nearly $4,500 per annum over other devices."

Traversing Crab Crane.—An ingenious, cheap and prompt mode of delivery is that used by Mr. E. B. WALL (P. C. & St. L. Ry.) at Columbus, O., and illustrated in Figure 22. It comprises a self contained steam crab crane, on a trolly having longitudinal movement over the whole length of an overhead traveling girder spanning three parallel coaling tracks, the girder having motion on rails carried on trestles 25 or 30 ft. high, one on each side of the coaling tracks.

The coal shipped from the mine in ordinary cars is shoveled into 2½-ton iron buckets at ground level, and the crane lifts one of the filled buckets and moves it over the tender, when the latch securing the hinged bottom is released; and the contained fuel falls into the tender. Mr. WALL says:

"I do not think that this form of coal wharf is the best for all purposes. Coal can be loaded more cheaply where prop bottom cars are used and the wharf arranged accordingly. At Columbus, however, we receive our coal in straight bottom gondolas, box and stock cars. At certain periods of the year we have to carry a supply of coal on the wharf, at other periods the coal can be loaded direct from the cars into the buckets. In designing our wharf we had to consider these conditions. When the capacity of this wharf is taken into consideration with its first cost, I consider it a very satisfactory solution of the problem. The cost of the maintenance of the structure is very light, and it can easily be renewed at any time without interfering with the operation of the wharf.

"The large timber constructions in general use are very expensive to maintain; they have to be renewed every six or seven years, and while with the drop-bottom cars they can be made to handle coal more cheaply per ton than the crane arrangement, nevertheless, when all items are taken into account, I think that the showing would be about even."

The capacity and cost of operation at Columbus is as follows:

Capacity of bucket, in pounds	5,000
Average weight delivered, per engine, in lbs.	7,000
Probable maximum capacity with fifty buckets and trestle at present length:	
Maximum number of buckets dumped per hour (tested)	20
Actual working hours (handling buckets)	21
Maximum number of buckets per month	12,600
Maximum number of tons per month	31,500
Allowing each bucket full of coal, also a loss of twenty minutes in time for each fifty buckets handled for the purpose of supplying crane boiler with fuel, water, etc., which equals about three hours in twenty four. Then:	
Present delivery in tons per month	9,120
Present delivery in buckets per month	5,142
Cost of plant	$7,760.00
Wages of (2) engineers per month, at 18 cts. per hour	129.60
Wages of (12) coal-heavers per month, at 12 cts. per hour	518.40
Wages of (2) men* dumping and signaling to craneman, per month, at 12 cts. per hour	86.40
Foreman of wharf (1) per month, at 13 cts. per hour	46.80
Fuel, oil, waste, water, etc., per month	12.50
Repairs to apparatus, per month	5.00
Interest on investment, per month, at 6 per cent per annum	38.50
Total operating expenses, per month	$837.20
Cost of coaling, per ton, in cents	.091
Cost of coaling, per engine, in cents	.3355
Not taking interest on plant into consideration, per ton, in cents	.067
Probable cost per ton, at maximum capacity	.068
Average length of time for coaling an engine	6 min.

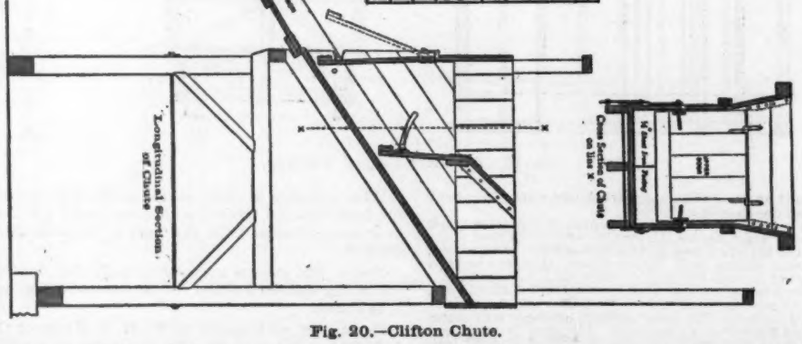


Fig. 20.—Clifton Chute.

It is possible that Mr. WALL'S original plan might be improved by the use of a "Gantry or Goliath Crane," as used in Europe, described and illustrated in Mr. G. J. APPLEBY'S paper on cranes, read before the American Society of Civil Engineers, Oct. 17, 1883. (See Proceedings, p. 374.) This dispenses with the trestle, as the whole crane with its long vertical legs traverses on tracks at ground level. The first cost of the crane would be increased, and there would be an increase in the power required to move it, but the system and storage could at a few hours' notice be indefinitely extended at the slight cost of increasing the length of the tracks.

Locomotive Hoist:—Another special apparatus is that designed by the late Mr. J. B. COLLINS, of the P. Ry. Mr. STRODE, of this committee, says it is preferred at Elmira because of the small yard room there available for coaling purposes.

The rate of delivery is one truck load of two tons in from 70 to 80 seconds, and four tenders have been loaded, with two trucks each, in 15 minutes and 25 seconds, an average of 3 minutes 51 seconds each. This includes the time of attaching and detaching chain from the locomotive and clearing the track for another locomotive to enter.

The cost, averaged over the first three months of 1887 (when the apparatus was not worked up to its capacity) is 7⅞ cts. per ton, delivering at the rate of 53.4 tons per day, and requiring three men per 24 hours, at 12 cts. per hour.

Structional Economies:—Our circular did not include any queries as to economies in design or construction of plant, but a few notes can be made from the accompanying chute drawings.

In manufacturing aprons, the G. T. Ry., the C., N. O. & T. P. Ry., and apparently the B. & O. Ry., use plate iron, stiffened with angle-irons; all others use timber aprons faced with sheet iron.

Earlier in this report we have noticed an instance of the use of levers instead of weights, for balancing the aprons. The C., M. & St. P. Ry., who use chains and weights, have an extra weight of oak which the chain lifts just as the falling loaded apron has to be brought to a state of rest. This may be easier in its action and cheaper than the additional iron weight usually used, but cannot, we think, equal the use of an additional length of stout chain that is lifted only at the last moment, giving a gradually increasing resistance to balance (neutralize) the cumulative energy of the falling apron.

In designing the timber framing (see Figs. 1 and 2, by Mr. MEEHAN) there may be a reduction in scantling and a saving in first cost if the chute or pocket be carried well over the outer frame or beyond the line of posts, as it permits the transverse timbers to be shorter, and the posts can thus be the more completely utilized in carrying the great weight (due to the stored coal, the coal cars, and sometimes a locomotive) that comes up on the structure.

Fig. 22.—Traversing Crab Crane. Pittsburg, Cincinnati & St. Louis Railway.

The intermediate flap door of the Clinton pocket dividing it into two chutes, would add about $30 to the cost of each 6 or 7-ton pocket.

On the B. & O. Ry., Fig. 19, it may be noticed that the joint at hinge between bottom of chute and apron is open or only covered by a wire screen, and a guide for the dust and a dust-box inside the timber frame is provided for the fine slack in a way similar to the screening apparatus often used with hard coal chutes. The dust-guide is so finished at top as to form an effective support for the apron in its lowest position.

Conclusions:—To summarize, it may be said that with

* These men are regular coal heavers, and only do the work of signalling when the foreman is busy checking up the time or taking numbers of cars. One is employed at night and one in the day time.

regular coal supply from mine in drop-bottom cars, the cheapest and most rapid delivery is by using high central trestle, from which the coal is allowed to gravitate into dimensioned chutes, and from the chutes gravitates into tender.

When sufficient land can not readily be obtained for the long ramp (grade) this system requires, the economy in labor and slight injury to fuel is so marked under this system as to suggest the advisability of lifting the loaded mine cars, vertically (by some form of power elevator) up to the level of track on top of the high trestle.

For a *compromise* system where the daily fuel issues are sometimes taken from cars and sometimes from store heap, either the tipping pocket on truck or chute filled by horse and cart may be used, or if the amount to be stored and lifted from heap be not large, an overhead girder crane, as used by Mr. WALL, will do. If a Goliath crane be used, the storage is practically limited only by the land obtainable.

For leisurely delivering comparatively small amounts, the platform, or, better still, direct shoveling from car to tender, is as cheap as any manual labor system known; and if it is desired to lessen the time actually occupied in delivering to tender, a hand crane and buckets on the platform will do so with but little outlay and but slight increase in cost over direct shoveling: in fact, if the use of buckets insures the men being steadily kept at work, the cost per ton may by use of crane be lessened.

In closing this report, we would say that it is apparent, from information received by your committee, that the railway department most keenly interested in the cheap and prompt delivery of fuel, viz., the mechanical department, is not on many of the railways of this continent usually intrusted with the design, manufacture, or working of the plant required.

This is a mistake, and, in the worst case that has come under our notice, resulted in the extravagant charge against the department of $1.25 for each ton of coal delivered.

Since the foregoing was written and approved by the Committee, we have received drawings illustrating Mr. D. S. DOCKSTADER'S side-dump coal car and oscillating apron, designed to deliver coal direct from car to tender without the use of shovel, and therefore at minimum expense.

It will be seen from an examination of the drawings that the floor of the car inclines upward from side-sills to center at so quick an angle that, when one of the side flap-doors (hung from top-rail) has its latch released the coal will freely slide out.

There are five compartments and five doors on each side, so that each of the ten pockets in a 30 ft. 20-ton car hold two tons.

A ramp and trestle 11 ft. 4 in. high are needed to lift the coal cars above the level of tender, and vertical posts carried up on both sides of the horizontal part of this trestle support metal hinges, upon which are swung aprons (of the width of the car pockets,) whose purpose it is to guide the coal into the tender. Under normal conditions the aprons stand upright and in line with the posts, thus clearing both tender and car, but the pulling on a short rope swings the apron into position for acting as a guide, and the pulling of a handle locks it there, after which the latch securing the lower side of flap door on car is released.

The first cost for plant and the daily outlay for labor are very light when this system is used, its chief defects (aside from the large yard space taken from the three parallel tracks) being the comparative uselessness of the cars for ordinary freight service on return trip to mines, so that the cars would probably only earn revenue on half their total mileage—if hauling company's fuel can by stretch of language be said to be revenue earning service.

J. DAVIS BARNETT,
JAMES STRODE,
CHARLES GRAHAM, } *Committee.*

DISCUSSION.

Mr. BARNETT—As to whether the flap door in front of the chute is necessary, I would very much like an expression of opinion upon. The Committee says it is useless. No doubt some parties consider it necessary, but it costs something to put on and to keep in repair. An open ended chute about 18 in. deep and trussed to the apron to keep the coal back, it seems to me is decided economy in constructing chutes. We are using it on the G. T. in Canada. The construction is quite simple. It simplifies the old construction now in use.

As to the cheapest and economical manner of handling coal into locomotive tenders, the Committee's opinion is: if you get the coal from the mines in dump cars, and are not limited in land, to run those cars on high trestles, dump that coal on a central platform, having chutes on each side of it, say when your platform has a reasonable amount of coal on, the coal will run from the chutes into the pockets, remaining there until the tender comes along and then when the tender comes along, drop your chute apron and drop your coal in. That is the cheapest manner of handling coal, narrowing the cost down to a very small fraction over 4 cts. and, allowing for interest, depreciations and renewals, all of which things should be covered, it will not add more than a cent and a half to that cost, so the absolute cost of delivering to the tender would be about 6 cts. The Committe had no figures before them showing any more economical delivery than that. The coal is not weighed in such an arrangement, but it is very easy to make a mark on the side of the chute, and under circumstances where you are liable to be troubled with rain in the coal, it is my opinion that measuring the coal by bulk is quite as satisfactory as weighing it. The net result for twelve months will be quite as exact. Many of us have not the opportunity of using dump cars for the delivery of coal and therefore we have to make compromise schemes, and it depends upon the amount of coal you have to carry, to carry you through the winter or carry you over labor troubles at the mines or troubles on intermediate road. It depends upon the kind of stock you expect to carry, what system you will devise for the delivery of coal. Suppose you use the chutes and run your cars up there and also have a large storage heap; if you cart from that storage heap in winter up to your chutes, it will cost you 15 cts. a ton, I feel quite sure under ordinary conditions. That is where you do not employ your horses and cart the year around, it will cost you 15 cts. a ton to deliver that way and by using such a scheme as Mr. WALL uses that sum can be reduced, and it is really a question of the kind of coal you have got to carry to decide which of the various systems in use about the country you will adopt to the best advantage and the least expense.

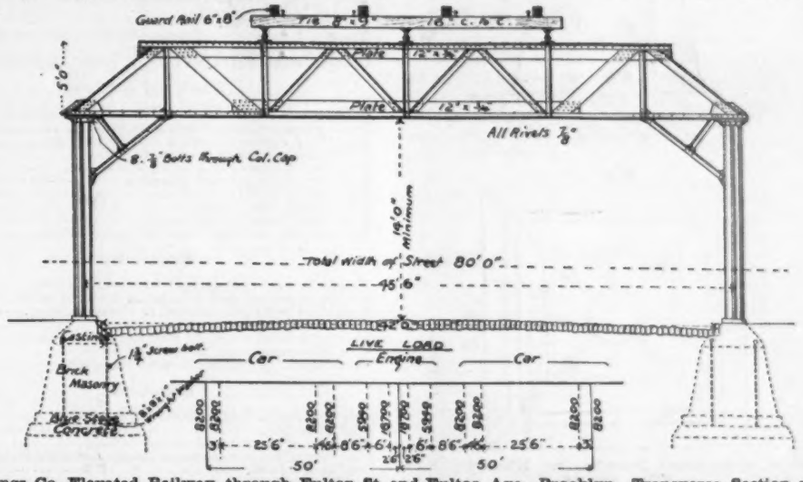
Mr. MEEHAN—The system just described is what we have had to use. We give the contract to two or three laborers, if necessary, for ¼ ct. per bu. The team useful in that service is useful in other services. At other points of our system we have a similar device, but not arranged so that it may be used quite as well, which costs us ¼ ct. per bu. We contract by the bushel in our part of the country.

Mr. MACKENZIE—Some years ago we introduced just such a system as Mr. BARNETT'S, leaving some 18 in. between the apron and bottom, and after using it a short time we had one man very severely injured by being knocked down. That was ordered off at once, and in place of having it permanent we put a chain at each end of the gate, and way over at the end is the windlass inside. The man who delivers the coal from the chute raises his apron to a vertical position and the coal is delivered just as he wants it. Our chutes hold 7 tons each, so if a man wants 4 tons he could have it and the next man get the balance of 3 tons. If he wanted more he would get it from another chute, and we found that plan to work a great deal better than the other.

King's County Elevated Railway of Brooklyn.

The views which we present herewith are of the structure which will undoubtedly be Brooklyn's chief elevated line for some time to come, if not always. Although the financial success of the first Brooklyn elevated line, which was opened in May 1885, has not been particularly brilliant on the surface, yet it has been brilliant enough in fact to encourage the building of a remarkably extensive network of other lines, as we have already noted, (Aug. 27), so that three new lines are expected to be opened together about Jan. 1, 1888, besides the one now running. The additional strain which this will throw on the already scanty traffic facilities of the bridge is a factor which is already attracting great attention in Brooklyn, and insures that no effort will be spared to solve that great problem promptly and correctly.

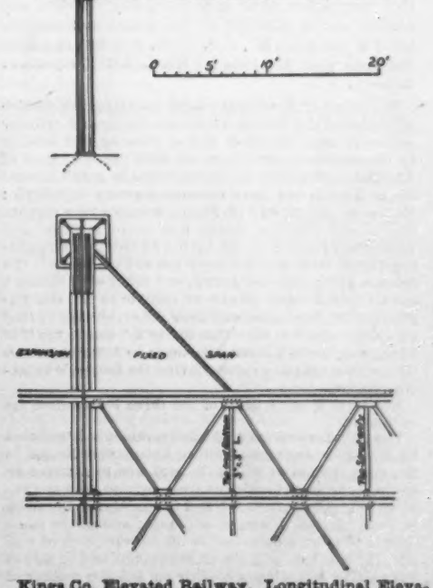
While the King's County Elevated Railway of Brooklyn is one of the latest of such rapid transit structures, the plans were made some years ago, we understand, and can hardly be taken as a type of the most advanced practice, especially as the designers were handicapped by the requirements of the rapid transit commissioners as stated below; the



Kings Co. Elevated Railway, through Fulton St. and Fulton Ave., Brooklyn. Transverse Section and Rolling Load.

structure presents few features of novelty requiring comment. The company's principal route and the one now building is from the Fulton ferry along Fulton street to East New York, about five and a half miles, with a connection provided to the East River bridge.

Work was first commenced in the winter of 1885 when a few foundations and one span of the structure were built. Legal warfare and injunctions then stopped all work and it was not resumed until March, 1887, after the final decision in the company's favor by the Court of Appeals.

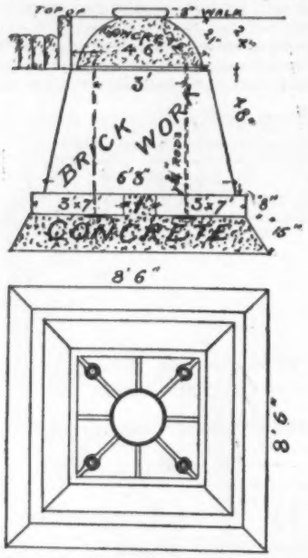


Kings Co. Elevated Railway. Longitudinal Elevation and Plan.

The rapid transit commissioners when prescribing the various routes for the King's County Company, specified that the structure should be of the lattice class and over the center of streets except at certain designated sections, and the structure was designed by the Phœnix Bridge Company, the contractors for the entire work to comply with that requirement.

Since the resumption of work in March last, Messrs. SHUNK & BRYSON, Civil Engineers, No. 1 Broadway, New York, have been the engineers for the railway company, the former as chief.

The cross girders are built and erected in pairs



Sketch of Standard Foundation. Kings Co. Elevated Railway.

and secured together after erection by diaphragm plates riveted to the vertical posts.

The rolling load and unit stresses are given in connection with our drawings, and we also give a sketch of the standard foundation for 50-ft. span, from which, of course, there are occasional variations, as circumstances require. A few of the piers in the vicinity of Fulton ferry have been placed on piles. The design of the foundations is much the same as was used in New York.

	ENGINE 444. *Strong.*	ENGINE 383. *Strong Cylinders.*	ENGINE 357. *American.*
Cylinders, etc.			
Cylinder, diameter and stroke	20 x 24 ins.	19 x 24 ins	20½ x 24 ins.
Diameter of piston rod	3¼ ins.	3¼ ins	2⅞ and 2¾ ins.
Number of valves per cylinder	4, 2 steam, 2 exh	4, 2 steam, 2 exh	One.
Type of valves	Gridiron.	Gridiron.	Balanced slide.
Number of ports per valve	10	10	3.
Size of ports	4⅝ ins. x ¾ in		
Full travel of valves	1¼ in	1⅛ in	
Lap of valves	1/16 in.		
Lead of valves, steam, constant	1/16 in.	1/16 in	
Lead of valves, exhaust	1/16 in.	1/16 in	
Throw of eccentrics	2⅛ ins.		
Tractive force per lb. of mean effective pressure on piston	154.8 lbs.	131.3 lbs.	149.11 lbs.
Cylinder clearance in cubic inches	481	448	568.
Cylinder clearance in per cent. of piston displacement	6.38 per cent	6.58 per cent	7.35 per cent.
Wheels and Journals.			
Driving and truck wheel centers (all tires of steel)	Wrought-iron	Cast-iron.	Cast-iron.
Front truck 4-wheeled swing beam	Yes.	Yes.	Yes.
Rear truck 2-wheeled swing and radius bar	Yes.	None	None.
Nominal diameter of driving wheels	62 ins.	66 ins	68 ins.
Calipered diameter of driving wheels	62½ ins.	65⅛ ins	66¼ ins.
Diameter of front truck wheels	30 ins.		
Diameter of rear truck wheels	42 ins.		
Total wheel-base of engine	30 ft. 2 ins.	22 ft. 9 ins.	22 ft. 1 in.
Rigid wheel-base of engine	5 ft. 7 ins	7 ft. 9 ins	7 ft.
Driving axle journals (diameter and length)	7½ x 10 ins		
Weights, etc.	Lbs.	Lbs.	Lbs.
Weight on first pair drivers, in working order	30 000		
Weight on second pair drivers, in working order	30 000		
Weight on third pair drivers, in working order	30,000	None.	None.
Total on drivers, in working order	90,000	74,640	63,280.
Weight on front truck, in working order	27,000	24,880	27,440.
Weight on rear truck, in working order	21,000	None.	None.
Total weight of engine, in working order	138,000	99,520	90,720.
Boilers, etc.			
Height of boiler center above rail	7 ft. 3 ins		
Kind of boiler	Twin furnace	Straight shell	Wagon top.
Diameter of barrel inside smallest ring	58 ins	55 ins	54 ins.
Diameter of fire boxes and combustion chambers, corrugat'd	38¼ ins. inside		
Length of grates	42⅞ ins. outside	11 ft.	11 ft.
Width of grates		3 ft. 4½ ins	3 ft. 6¾ ins.
Number of tubes, all iron	306	229	248.
Diameter of tubes, outside	1¾ ins	2 ins.	2 ins.
Length of tubes	11 ft. 5 ins.	11 ft. 4½ ins.	12 ft. 2 ins.
	Square Feet.	Square Feet.	Square Feet.
Grate area	62.	37.12.	39.2.
Heating surface, fire box	155	151.6.	142.3.
" " combustion chamber	93.		
" " tubes	1600	1234.3.	1429.8.
Heating surface, total	1848	1385.9.	1572.1.
Ratio of heating surface to grate area	29.8 to 1	37.3 to 1.	40.1 to 1.
Working steam pressure per square inch	160 lbs.	160 lbs.	140 lbs.

The tender had a capacity of 3,000 galls. and 10,000 lbs. coal, and weighed, loaded, 70,000 lbs.

The Strong Locomotive Tests.

Continuing our report of last week of the tests of this very interesting and promising novelty, and coming to the question of the actual economic results of the tests, Mr. J. S. COON, who was in immediate charge of the tests for Mr. LEAVITT, reports as follows:

The object of these tests was to determine the relative efficiency of the Strong locomotive boiler and cylinder and valve gear, and their ease of working and liability to derangement, as compared with the best type of American locomotive in common practice at the present time. To this end three locomotives were tested, viz.: Engine No. 444, fitted with Strong's patent twin furnace boiler, and Strong's patent four-valve cylinder and valve gear; Engine No. 383, having an ordinary straight-top boiler, with fire-box over instead of between the frames, anthracite coal grates, and fitted with Strong's patent cylinder and valve gear, similar to No. 444: Engine No. 357, having an ordinary boiler, similar to that on Engine No. 383, save that it has a "wagon top" of 8 ins., and the link motion common to American practice, with plain slide valves having De Lancey's balancing device.

The leading particulars of the three locomotives are as follows:

The peculiar feature of the improvements introduced by Mr. STRONG are embodied in Locomotive No. 444, in the construction of which the aim was to produce an engine capable of heavier express service than any engines heretofore produced, and to accomplish the same without increased weight per axle; and at the same time to be more economical in the consumption of coal than the best type of slide-valve engines, and be able to burn either bituminous coal or an inferior quality of anthracite. To accomplish these ends requires a more efficient boiler, and better steam distribution in the cylinder than obtains in the best American locomotive practice heretofore existing.

The boiler of Engine No 444, has two circular corrugated furnaces united to junction-piece or "breeches" pipe, which leads to a circular corrugated combustion chamber. The corrugated cylinders require no staying of any kind, and are free to expand and contract without overstraining the outer shell. Any mud or scale which may accumulate on their surface cracks off when the plates cool, and falls to the bottom of the boilers, whence it may be removed through holes provided for the purpose. The front end of the combustion chamber is flanged out sidewise to the shape of the ordinary tube plate, from which point forward the boiler is of the ordinary type.

The outer fire-box shells are two plain cylinders, requiring no staying save at their lines of intersection, which are securely held by a vertical plate between the furnaces. This vertical stay plate also serves to prevent the side wash of the water in rounding curves. At the front of the furnaces a hollow casting covered with fire clay runs across the furnace, into which casting are introduced the front ends of the hollow wrought-iron grate bars. This arrangement accomplishes the double purpose of preventing the burning out of the grate bars by the cold air passing through them, and the introduction to the combustion chamber of the air necessary for complete combustion of the gases.

The steam cylinder of Engine No. 444 has one short port at either end, at each end of which are arranged two vertical "gridiron" valves, one for admission of steam, the other for exhaust. The valves work on flat or plane seats whose outer surfaces are ground circular to fit in holes bored in the passages leading from the saddle to the cylinder, dispensing thus with the ordinary steam-chest. Each valve seat has ten ports each 4⅝ ins. long and ¾-in. wide. This gives a port area of one-ninth the piston area.

All four valves of one cylinder are operated by one eccentric, the mechanism being of the radial type. To each eccentric strap two rods are attached, one rigidly, the other by a pin, the rigid one operating the steam valves, the other the exhaust. Both eccentric rods have fulcrum pins some distance from their ends, connected by suspending links with blocks free to slide on arcs struck from the fulcrum-pin centers. The positions of the blocks are controlled by the levers in the cab. At the ends of the eccentric rods are other pins connected with the main rocker arms by links. The main rockers are connected with other rockers over the cylinder, the latter rockers being connected to the valves by links in an enclosed casting bolted to the cylinder. The dimensions and arrangement of the gear are such that when the suspending blocks are placed at mid-gear, at the middle of the arcs, the valve-travel equals only the lap and lead, any position of the sliding block giving the fulcrum-pin an inclined travel, the latter representing the port opening. In practice the exhaust valves run at full gear at all times, the block being moved only when the engine is reversed. The arrangement of the gear is such that after a valve has traveled the amount of its lap it comes to nearly a full stop, while the corresponding valve at the other end of the cylinder is doing its work, and as the load comes upon the valve during this period of rest there is very little wear. Among the advantages which this gear possesses over the ordinary link motion is the use of two eccentrics instead of four, and the entire absence of block-slip, there being nothing but pin friction.

The boiler of No. 444 was constructed at Edgemoor, Delaware, but the engine was built at the Wilkesbarre shops of the Lehigh Valley Railroad, by Mr. ALEXANDER MITCHELL, Superintendent and Master Mechanic of the Wyoming Division.

Locomotive No. 383 has the ordinary locomotive fire-box boiler, with straight top, the water-leg resting on top of the frame. The cylinders and valve gear are of the Strong type, similar to those on Engine No. 444.

Locomotive No. 357 has the ordinary wagon-top fire-box locomotive boiler, and the link-motion valve gear common to American practice, the slide valves having De Lancey's balancing device. This locomotive is a thoroughly first-class job, and represents the highest type of the American express locomotive.

MANNER OF CONDUCTING THE TESTS.

All the locomotives were subjected to exactly the same work, under similar conditions. The run was from Wilkesbarre to Mauch Chunk, about 55 miles, with a train of 5 passenger cars, returning a train of 8 cars. This route is a continuous succession of curves as sharp as 14°, and grades as steep as 96 ft. per mile.

The water supplied to the tender on each trip was gauged at the center of gravity of the water space by long glass gauges. The tender was filled nearly full of water and placed on the track scales, the height of water, in the glass gauges being marked on the scale. These were the 0 marks. The water was then drawn off 5 cwt. at a time (560 lbs.) and corresponding marks made on the scale, each division thus representing 560 lbs. of water. The readings of both scales were taken immediately before and after taking water, and at the end of the run. The same tender (that of Engine No. 444) was used on all the trials, without alteration.

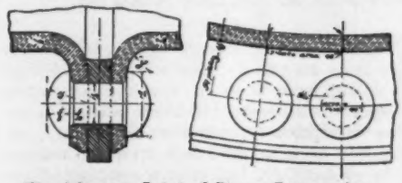
All the coal for each run was weighed. At the beginning of each run, before any coal was charged to the experiment, the engine was allowed to start with a uniformly good fire. It was not practicable to get the weight of the ashes. The boiler pressure was taken at five-minute intervals on each run. The temperature

of the feed water, at the three tanks where water was taken, did not vary half a degree from 64.3° F. throughout the trials.

All indicator cards were taken on up-grade, on the outward run from Sugar Notch to Fairview, and on the homeward run from Mauch Chunk to Glen Summit. Two operators took simultaneous cards from each end of both cylinders, while a third operator in the cab noted the corresponding steam pressure, position of throttle lever and reverse lever, and the exact time the cards were taken. The cab observer also noted the exact time of passing the mile posts, and the time of stopping and starting at stations.

The indicators were the Tabor, and certainly no disparagement to any other make of indicator is intended when it is stated that the indicators, apparently, were absolute perfection. The indicator rig, for reducing the piston motion for the indicator barrel, was a modified true pantograph motion, the suggestion of Mr. F. W. DEAN, and it was also apparent perfection. The strings used were hard-braided linen, about 8 ins. long. Cards taken at 60 miles per hour are not more than .03-in. longer than those taken at one mile per hour. No shields were used, and not the slightest difficulty was experienced in taking accurate cards at over 60 miles per hour. At speeds much exceeding the latter, wind shields would be a convenience.

It is worthy of note that when 444 drew 8 cars up the 96-ft. grade from Sugar Notch to Glen Summit, the



The Adamson Joint of Strong Locomotive.

safety valve blew off when nearly up the hill, using soft coal. It is to be observed that 444 made the run successfully on screenings from the coal dump. The Lehigh Valley Railroad have no other engine capable of the same service on such fuel. It is further worthy of note that in changing from anthracite to bituminous coal no alteration whatever was made to 444. Either coal can be burned with a double 4-in. exhaust nozzle. The fireman had not become sufficiently expert to prevent the steam blowing off when running down grade. Not so much blew off on May 19 and on May 18, which makes a difference of 1,700 lbs. of water consumed.

While 444 used more water than either of the other engines, its consumption of coal, of the same grade, is far below the others, which fact indicates the marked efficiency of the Strong boiler.

The main details of the comparison made are as follows:

If the consumption of coal of the three locomotives be compared, each on two trips when they were using the same grade of coal, to wit: Locomotive No. 444, on trips No. 4 and No. 19; Locomotive No. 383, on trips No. 8 and No. 14, and Locomotive No. 357, on trips Nos. 12 and 13, it gives the average for the three respectively, as follows:

Average for Engine No.	444	.....	6,537 pounds coal.
" "	383	.....	7,441 "
" "	357	.....	8,087 "

which is a difference of 646 lbs. between Nos. 383 and 357, or an advantage of 8.7 per cent. in favor of Engine No. 383, and a difference of 1,550 lbs. between Nos. 444 and 357, or an advantage of 23.7 per cent. in favor of No. 444. It is also to be borne in mind that Engine No. 357 has 2 sq. ft. more grate area and nearly 200 sq. ft. more heating surface, and much better steam room than No. 383. With equal boilers there would be still greater difference in the coal. In support of this, compare the two runs of Engine No. 383, on May 2 and May 10, and Engine No. 357, on May 7 and May 9, as to water required from Mauch Chunk to Glen Summit, all the way up grade, and no blowing-off took place. On these four runs the load was precisely the same, about 431,600 lbs., besides engine and tender. The mean consumption of water from Mauch Chunk to Glen Summit for the two runs mentioned, for the two engines was:

For No.	383	.....	17,942 pounds.
"	357	.....	21,585 "

a differences of 3,643 lbs. in favor of No. 383, or 20.3 per cent., which must be attributed solely to the superiority of the Strong valve gear over the best type of link motion.

The only portions of the Lehigh Valley Railroad covered by the tests, where the locomotives were brought into competition as to speed, are between Sugar Notch and Fairview, going south, where the maximum grade is 96 ft. per mile, and between White Haven and Glen Summit, going north, where the maximum grade is 69 ft. per mile. It is usual, on the trip north, with train No. 2, to have a helper from White Haven to Glen Summit, but none was allowed on the trips whose results are given in the tables. The running time between the stations represent the relative strength and speed of the several engines, as each was expected to make its utmost speed between these points. On other portions of the road any of the engines could much more than make running (schedule) time with the trains handled.

It is an interesting and suggestive fact that Engine No. 444 made its fastest runs on these days, May 18, 19 and 20, when it drew the heaviest trains. The reason for this was well understood by all disinterested parties connected with the test.

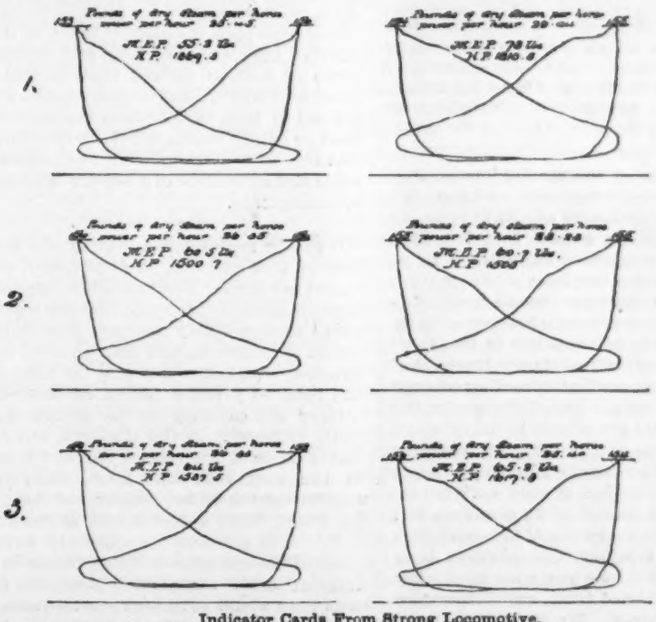
If the two fastest runs of Engines Nos. 383 and 357 between Sugar Notch and Fairview be taken, viz., May 9 and 10, there were nineteen sets of indicator diagrams taken on each of those runs between the points stated. The mean initial boiler (gauge) pressure for the nineteen sets of cards is for—

Engine No. 383, May 10, mean boiler pressure .. 159 lbs.
Engine No. 357, May 9, mean boiler pressure .... 151 lbs.

If these be multiplied by the tractive force per pound of mean effective pressure on piston of the two engines, viz.:

Engine No. 383, 131.3 × 159.0 ..... 20,877.
Engine No. 357, 149.1 × 151.0 ..... 22,514.

With the same valve gear these products should represent the relative strength and speed of the two engines. In other words, Engine No. 357 should have been 7.8 per cent. quicker than Engine No. 383. But, on the contrary, Engine No. 383 ran from Sugar Notch to Fairview in 22 min. 39 sec., and Engine No. 357 was 25 min. 0 sec., making the same distance, with the same load, or 9.4 per cent. slower than Engine No. 383. It would seem as though but one inference can be drawn from this, to wit: the marked superiority of the Strong valve gear over the link motion in getting rid of the exhaust steam. In other words, it is 9.4 per cent. plus 7.8 per cent.—17.2 per cent. better in this particular instance.



Indicator Cards From Strong Locomotive.

(Taken on the Northern Pacific Railroad, June 24, 1887, while locomotive was pulling 13 cars, 10 and 8-10 miles in 11 minutes. Weight of train, exclusive of engine and tender, 370 tons, with engine and tender, 476 tons, which would make the resistance per net ton 31.2 lbs. Boiler pressure, 160 lbs.; piston speed, 1,324 ft., or 326 turns per minute.)

The above is followed by elaborate tables which appear to us to fairly support the conclusions given, as fairly at least as is possible from what is after all a limited range of tests, which can by no means be regarded as absolutely conclusive in respect to details. Their main results may be summarized thus:

Lbs. water per lbs. coal:

Strong engine,	444	(6.33 to 8.56)	7.31
Strong Cylinders,	383	(5.23 to 5.78)	5.45
American engine,	357	(5.79 to 6.30)	6.00

This is a very good comparison indeed, and we are inclined to believe fairly indicates the great economic advantages of the Strong duplex fire-box, large grate area and ample combustion chamber beyond the fire-boxes. These advantages should be especially conspicuous in burning bituminous coal, and that they are so is indicated in a measure by the fact that the average of the bituminous tests only was 7.02 lbs. against 7.10 lbs for the anthracite only. The average is far in advance of average American experience with engines doing heavy work.

In pounds of water per H. P. the comparison is not so favorable, although all the performances are good, being as follows:

Lbs. water per Ind. H. P. per hour:

Strong engine,	444	(25.77 to 31.05)	27.94
Strong cylinders,	383	(21.33 to 25.41)	23.72
American engine,	357	(26.40 to 31.75)	28.42

The average speeds were 31.63, 32.89 and 30.64 miles per hour, or substantially the same. In pounds of coal per H. P. per hour, the superior evaporative efficiency of the Strong engine brings it well up, as follows:

Lbs. coal per Ind. H. P. per hour.

Strong engine,	444	(3.38 to 4.16)	3.78
Strong cylinders,	383	(3.05 to 4.07)	4.32
American engine,	357	(4.10 to 5.48)	4.72

These results were obtained when the engines were developing an average of some 900, 800 and 700 H. P. respectively, or working very hard. The performance is an excellent one. It is not probable that the average American engine in good order does materially better than the last given under these conditions, for it is not fair to compare these with M. MARIE'S tests on the Mt. Cenis, where he loaded his engine lightly and ran it up the long grade at but little more than 15 miles per hour, as we find done in one discussion of these tests. The 2.88 lbs. per I. H. P. per hour, and 6.88 lbs. of water per pounds coal obtained under these entirely favorable conditions is much better than can be obtained in practice under ordinary American or any other conditions, which will rarely give better than 4 to 5 lbs. of coal per I. H. P. It would, however, be interesting and desirable to make a test of the Strong engine designed to favor it in every way, so as to show the most economical generation of power of which it was capable, and such a test might not show much better than the above.

That the Strong locomotive is capable of most excellent work at high speeds, and hence that it is well adapted for hauling heavy through express trains is indicated in the clearest manner by the accompanying indicator diagrams, which we feel safe in saying are of unparalleled excellence for so high a speed, especially in the small loss of boiler pressure, while nothing could speak more eloquently in favor of the boiler than that the nearest which any rivet or stay-bolt comes to exposure to the flames is that shown in the accompanying cut of the Adamson joint, by which the different sections of the corrugated boiler are connected together.

Taken altogether, the facts of this report are certainly highly favorable to the Strong locomotive, although they should by no means be taken as conclusive as to details. We learn with pleasure that quite a number of new Strong engines are now building for the Michican Central, Atchison, Topeka & Santa Fé and other roads, and shall certainly expect to hear that they are justifying their existence by making a good record.

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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THE best system of coaling for locomotives, whether by chutes, dump cars or from platforms, is one which hardly admits of exact determination, for the reason that it varies greatly with the number of engines to be coaled per day and other local conditions, but perhaps the best existing collection of information on the subject in print to guide a choice is the paper which we republish in this issue from the last report of the Master Mechanics' Association. As the method of coaling adopted has, or ought to have, a great influence on the laying out of yards and shops, it constitutes a paper which it will be well for every engineer to fix in mind. The Master Mechanics' Association does a great deal of good work in preparing its reports, and of all its members, Mr. J. D. BARNETT, the chairman of the committee which made this report, has perhaps been most conspicuous of late years for his fidelity to that often neglected trust, appointment on technical committees. His report last year, on locomotive boilers, was one of the most careful and exhaustive which has ever appeared in the Association's proceedings.

ONE defect of omission, however, we regret to see in this report. It apparently attaches little importance to facilities for keeping a coal account with individual locomotives or enginemen, and hence may have the practical effect to lead to neglect of such facilities. The keeping of such accounts is still the exception, but there can be no doubt that it tends powerfully to improve average efficiency in handling locomotives. One further and great improvement might be made in the system, however, which so far as we know has never yet been made,—to make the coal allowance so much per car-mile instead of per engine mile, in freight service at least, thus making it for the interest of the locomotive crew to haul as many instead of as few cars as they could. Were a certain range of discretion then allowed to the men as to the number of cars they would haul, the practical effect would be, we cannot doubt, that 5 or 10 per cent. more cars than the regular allowance would be hauled in good weather, as they might perfectly well be, with perhaps an occasional cutting down of a car or two in bad weather which would be equally advantageous. In all labor questions, the wise man is he who strives in every way to make the interests of employer and employed correspond, and so lets self-interest instead of arbitrary rules regulate the amount of service rendered.

THE Brooklyn bridge has been singularly free from accident in the operation of its cars, as has also the New York elevated, and the reason has been beyond question an unceasing vigilance, which has resulted from the consciousness of imminent danger. Such vigilance is the only price of safety, and no traffic of such magnitude can be handled long without accidents, simply because, the longer the immunity the greater the danger that it will destroy that ever-present caution by which alone it is secured.

The slight accident from a derailed car on the bridge, which is noted elsewhere, can hardly be said to have been due to a lack of vigilance, however, unless there may have been some defect in the switch, but rather belongs to the class of accidents from frogs and switches which all railroad men know cannot be altogether avoided by any amount of care. As such, it sheds a rather lurid light on what would have been the consequences of (1) multiplying the number of frogs and switches by three or four (2) putting them in the main track over which loaded trains pass at speed instead of in a yard beyond the main track, used by empty trains out of service only, and (3) running the trains over the switches by cable and in the face of a rapidly approaching opposing train.

It will be remembered that in our first article on this question, on June 4, 1887, we discussed the danger likely to result from oblique head collision only, saying nothing about the added dangers likely to result from frog and switch derailments, and then pointed out the strangely overlooked fact that the plan which had been so joyfully hailed as doubling or tripling the capacity of the bridge did not really increase it in the slightest, but rather decreased it, if due regard was had to safety. In the next following issue, however, we pointed out the added danger resulting from the added frogs, switches and crossings, and in this week's incident we already have evidence of the importance of this danger in a derailment under vastly more favorable conditions than would have been possible under the former proposed system. The same derailment in the latter case might well have resulted, and would have been more likely than not to result, in heavy loss of life.

THE wise man learns a lesson from such incidents as these as completely as if the loss of life had in fact taken place, although the public in general learn nothing until they are compelled to by some dire catastrophe. It is to be earnestly hoped that the Brooklyn bridge trustees do not belong to the latter class, and hence that the lesson of this late event will not be lost on them. It has seemed well to point out the lesson distinctly, first as the only answer we have thought it worth while to make an attempt to lead the Brooklyn public to believe that our allegations of such danger were "forced and hypocritical," which was made in an interview reported in the Brooklyn *Eagle*, and secondly because we have direct information that one of the plans which have been urged in influential quarters is to make a series of stub station switches, spread out like the fingers of one's open hand, thus admitting the force of our criticisms on the capacity of the formerly proposed system, but multiplying many fold the dangers. While no such suggestion is likely to receive serious attention, it is hard to say what may happen in this work-a-day world, and this derailment shows us practically that the one thing which should be taken as an axiom in planning a system of bridge transit is that no single frog or switch of any kind should be admitted to the main service track, if possibly avoidable.

IT is now definitely settled that Mr. BURGESS has for the third time outdone himself in the design of fast yachts, within two years, a record wholly without parallel in the annals of ship-building. It is fortunate that he did so, for the indications seem clear that the *Thistle* could have beaten the *Mayflower*, but cannot the *Volunteer*. There is the usual talk in favor of the *Thistle*, which has been common in the last two contests as well, but it seems sufficiently clear that this comes in part from courtesy, in part from anxiety, and in part from a laudable anxiety not to be too cock-sure, but to be able to say "I told you so" whichever side wins. We would not have it understood that we feel cock-sure of the result. The *Thistle* has certainly a fighting chance, but we have no desire to be able to say "I told you so," and advise all our readers to bet no money on her,—or any other vessel. It will be bad for us if she does win, for it is hardly an Irish bull to say that the America's cup is the sole feather in the maritime cap we wear now-a-days. If we lose that, all will be gone save honor, and not much of that left.

THE air-bubble talk about the *Thistle's* bottom has been an amusing feature of the contest. It would have been in the highest degree unsportsmanlike to introduce any such device surreptiously, whether technically admissible or not, and hence it had no reasonable probability, but that something of the kind might be devised to aid the speed of vessels is not so utterly impracticable as has been assumed. In fact, a correspondent of the *Tribune* points out that something like it was invented and put into practical operation by the late Commodore E. A. STEVENS, under whose direction the passenger steamboat, *John Nelson*, plying between New York and ports on the Raritan river, was provided with a system of force pumps and pneumatic arrangements by which in crossing shoals or whenever a higher speed was desired, the boat could be elevated several inches above the usual displacement and so held for a period of fifteen minutes. He also relates an experiment made nearly forty years ago on the Hudson River passenger boat *Hendrick Hudson*. The late ISAAC NEWTON, then one of the principal owners of the People's Line, devised and tried a method of accelerating the speed of the vessel by placing a cask of oil in the extreme fore part of the hold, and by means of a forcing pump ejecting the oil, in two small streams, through the bottom of the vessel on either side of the keel. The experiment is stated to have been an entire success. The machinery and paddle wheels which were at that moment making twenty-four turns per minute, immediately increased to twenty-five and maintained that rate as long as the oil was supplied. It was justly remarked, however, that although the theory was correct, that there was "no money in it," and that method of assisting speed has never become popular, nor should anything like it ever become so in yacht racing.

THE American Institute of Electrical Engineers have some provisions in their constitution which are quite novel, and which are certainly worthy of note by members of all other such bodies. One of these is that no person whatsoever can enter that body as a full member. He must be elected first as Associate, and afterwards transferred if found worthy. This tends to keep the lower grade full by removing the very common objection to applying first for a lower grade. The second peculiarity is that all elections are by the Council, the members having nothing to do with it. This is practically the condition in the Institution of Civil

Engineers and some other English bodies, but it is formally so in no other body that we recall, nor does it appear to be altogether desirable, although far more so than the present system of the American Society of Civil Engineers without some modification to impede malicious black balling such as we suggested last week.

The third peculiarity is that this body has a special Board of Examiners outside of the Council proper, to aid them in their duties of examining the qualifications of candidates, and with the exclusive right to provide rules for testing qualifications. Many technical organizations might find a useful hint in this, since there is in many of them too great a tendency to throw all executive, legislative judicial and inspectorial functions on a single small body.

IT is rather significant that of the patents issued in Canada in the last month reported, which we take to be a fair average month, there were out of a total of 298 patents;

	No.	Per cent.
American	191	64
Canadian	79	26⅓
British	22	7⅓
German	3	1
Belgian, Austria and France, 1 each	3	1
Total	298	100

In other words, about nine times as many American as British patents are taken out in Canada, if this month is a fair sample. The predominating part which this country takes in industrial Canada as compared with Great Britain could not be more clearly indicated.

By comparison with the total issue of American patents, which is now some 1,900 per month, it would appear that only about one in ten is deemed worthy of patenting in Canada likewise, the double patenting serving as a sort of winnowing process to weed out the less valuable patents. If we allow something for the influence of home residence and say that one-fifth of the Canadian patents are of practical value comparable with the average of the foreign—and this would seem a liberal allowance—we shall then have a still more remarkable comparison, for it will then stand as follows:

	No.	Per cent.
American	191	81.3
Canadian (equated, ⅕ of all)	16	6.9
British	22	9.3
All other	6	2.5
Total	235	100.0

We do not give this as in any way precise, but that it indicates approximately the true ratio of the part taken by the various peoples in the introduction of new mechanical processes and methods into Canada we take to be undeniable, nor is the record in any respect discreditable to Canada. It has only 7 per cent. of the population of the United States, and a vastly less per cent. of industrial activity. In proportion, the number of valuable patents is larger than could be expected on this basis, and larger we suspect than the truth.

From 20 to 25 patents per month are taken out in the United States by Canadians, or a little more than one-fourth of the number taken out at home, the inducement for a Canadian to take an American patent being vastly greater than for an American to take a Canadian, so that we might expect a still larger proportion.

FURTHER very remarkable tests of the WESTINGHOUSE brake, or rather of the new triple valve, were made at Burlington on Sept. 20. The results in a word were that in the very quickest stops of 50 car trains there was absolutely no shock. In the whole list of Mr. WESTINGHOUSE' mechanical achievements there is none more remarkable than is, which appeared to all other observers impossible.

Our City Pavements.

We give up considerable space this week to a paper dealing with the great question of city pavements. We wish it were more complete, but so far as it goes it certainly gives a clear idea of actual experience, and we cannot but feel it desirable, by every means in our power, to increase the attention given to this great question, in which average American practice is so bad. We take it that the chief reason for this bad practice is the political condition of our cities, which seems likely to continue so long as immigration is so rapid and constant, and which results in making the city engineership and the awarding of city contracts more or less political questions. The tenure of office being dubious there is less care in the discharge of its duties. If this be not so, and a man in time become expert, he is likely about then to be removed, if not before, as too old a public functionary; and if this be not so again, he is all the more likely to be driven from the public service by too low a salary.

Whatever the cause, the condition of the street pavements of all our American cities, with one possible exception, is beyond doubt a national disgrace. Our city pavements are the poorest of the whole civilized world, as are also our country roads, and what is worse, their average condition grows no better, but rather worse. No doubt each individual city has streets better paved than they were 20 or 30 years ago, but comparing cities of equal population in the two epochs there has been no visible improvement. The horrible cobblestone pavement, which is the rare exception in Europe, and is found only in the poorest streets of the smaller places, is still more used than any other stone pavement here, while the distinctively American devices of wooden pavements and artificial asphalt have done but little to improve the situation.

Even where we use stone block pavements they are mostly of inferior quality, as on Broadway, New York. In Europe there is found no difficulty in getting such pavement laid in the best manner at a cost which brings it within the means of the smallest towns. As a consequence, their street surfaces are firm and durable, the stones closely laid, the surface dry and clean. No one can be a day abroad, in any European city, without being struck by the contrast, for although most of our large cities have single streets of which there is no great reason to be ashamed yet the average condition of all the streets is far inferior.

For this no such excuse is possible as may be reasonably made for the bad condition of our country roads. This is a new and still thinly settled country, with a vast aggregate of road mileage, which never has been and is not now needed for any other than local purposes or pleasure driving. Some contrast in its condition with European roads is pardonable, therefore, although not so great a contrast as exists. But our cities are busier and richer than the average European city of equal size, and have no greater mileage of streets to provide for (unless some allowance for their more rapid growth should be made) while most of the pavement in which the contrast exists has been laid within the last twenty years, both here and abroad.

We must therefore all admit either that we are a less intelligent and capable people, or that our city administrations are culpably inefficient, or dishonest, or both. The first not being fairly supposable, we are driven to the last, which indeed we all know in a general way, although the extent of the injury which it has done us in the matter of pavements is little appreciated.

The contrast is made still worse by inefficiency of our street-cleaning departments That of Boston is probably the best, but not one of them compares in efficiency with European practice, although their cost is far higher in proportion. And as if this were not enough, when we come to street car tracks the contrast is far worse yet. The rails in European cities are, with rare exceptions, all flush with the paving, and have only a narrow groove in them to receive the flange of the wheel—too narrow to permit the tire of a wagon or carriage to sink into it. As a consequence, they are no obstruction at all to the passage of vehicles. Even light carriages and cabs pass over them without the slightest inconvenience, while on the other hand there is nothing to encourage or even permit them to stick to the track as so many of our vehicles do, being guided by the rails as effectually as if they had a flange. In Basle, and we believe some other cities abroad, the pavements are so perfect that they even run street cars like omnibuses, directly over the pavements, with flangeless wheels. The consequences of such an experiment on the best of our block pavements may perhaps be imagined.

On the other hand, in this country there are no street rails which are not a serious impediment to the use of the streets by vehicles, while the most of them have been deliberately designed, as Mayor HEWITT revealed, to make the use of the streets as inconvenient as possible for teams, by directly reversing European practice, and instead of having a flat top rail with a groove in the center, putting a ridge in the center with a wide depressed flat base on each side of it. This inevitably results in wearing a groove in the pavement both inside and out, close to the rail, and such grooves may be seen in nearly all our streets. Any other people but Americans would have indignantly revolted at such an abuse, at least after the malice aforethought which dictated it was revealed, but it is hard to find a limit to our long-suffering kindness toward abuses, and more of this rail is being laid down at this minute in this city, and probably in several other cities.

What between the dirt, the bad pavement and the street car tracks, the contrast between our own and European streets ought to make every American blush for shame, especially as it is hard to see any reasonable prospect of early improvement. One of the greatest blessings which could happen to the country would be the discovery of an accessible supply of natural asphalt rock, and as nature has given almost everything else to this country this may be found in time. The coal tar poultices which are used as a substitute have little to recommend them, and would then probably go out of use. The differences of view as to brick pavements, such as are revealed in the discussion elsewhere published, come largely, we surmise, from difference in the quality of the brick used, and the necessity of guarding this with watchful fidelity is the chief reason why brick is not likely to prove satisfactory, although it otherwise should make an excellent pavement for light traffic. The same is in a measure true of wood. The cedar pavements are rendering a fairly good account of themselves, and give a beautiful surface while in good condition, but the trouble with most of them is that the foundations under them are bad and that the blocks are not as carefully culled and laid as they should be. The permanent reliance for most of our pavements must be on stone, and as to that we have much to learn, especially in the way of the *awarding* of contracts. Our engineers would soon have good pavements in our cities if they were made

secure in their positions and left alone in managing the work, but aside from the fact that the average city engineer's position depends more on his political than professional skill, there is such slight competition and such undisguised favoritism in awarding contracts that the price is almost invariably unduly high and the quality of the work unduly low. It is a mortifying and irritating fact that in street paving a sin not a few of her things, we spend more money than any other people, and get the poorest results. Every American and every engineer should do what he can to bring about a change.

Another defect of our practice greatly intensifies and almost lies at the bottom of the evils above referred to, and that is the lack of system in disposing of our underground street furniture. The best pavement that engineering skill and unlimited means could devise is of no avail if this pavement is to be constantly broken for the introduction of new pipe or conduit systems, or the repair and extension of old systems. New York is a frightful example just at the present time of what this evil means, but every American city is encountering the same difficulties though perhaps in lesser degree.

If Broadway and many of its main tributaries could be laid bare for a depth of 10 or 12 ft. a perfect maze would be revealed of sewers, water, gas and steam-heating pipes, pneumatic tubing, electric conduits, etc., that intertwine and overlay each other in a meaningless tangle. This is the result of work done at widely separated periods and done with little knowledge of what has gone before and no regard for what may follow. It is now a task of extreme difficulty and cost to find room for a new pipe line at many points, and the time must soon come when the limit of the present practice will be reached from sheer inability to weave another system though the present tangle. And what then?

Our inventors will continue to improve upon past methods, and under the present practice we will only continue the work of destruction and obstruction indefinitely by tearing out old systems and replacing them by new. In so doing we waste all that money represented by the digging, bracing and refilling of trenches, which is a very considerable item in such work, and the constant interference with travel and business can only be estimated in its money value. The best laid pavement in the world will show the result of such breaks in the irregularity of its surface, no matter how carefully replaced, and this tearing up and replacing of pavement is an obstruction in itself, and costs much money. Then, too, pipe systems buried in the ground, whether intended to convey water, gas or steam, are constantly leaking and in need of repair; it is but natural that they should do so when the load upon them is great, and the foundation beneath a yielding one. In a word, the chief, and almost only, virtue of the present practice is that it don't cost quite so much money *just now*.

The only radical remedy for this evil is a very costly one in its first inauguration, but it is one that would doubtless be economical in the end, and that is a subway or series of subways under our main thoroughfares. And until this is done we can never hope for good, permanent pavements and clean, unobstructed streets. Such a subway should contain all existing conveyors of sewage, water, gas, steam and electricity, and be so arranged that these conduits would be always accessible for connections, additions and repairs or replacement without breaking the street surface. Were the data accessible it could doubtless be proven that the City of New York has already spent much more than the cost of an ample subway in its past and present practice, with the sole result of unreliable buried systems of pipes, a constant succession of very bad pavements and the blocking of its main lines of travel.

We can not blame those who went before us for the present trouble; it is a thing of unexpected and slow growth as far as they were concerned. But it is a reproach to our intelligence and the times we live in to simply intensify and make worse the tangle bequeathed to us. The problem must be solved in the near future and the time will arrive when it can no longer be dodged. So what is the use of simply magnifying the ultimate cost of introducing a permanent, and now much needed, improvement?

Chicago Street Pavements.

The Chicago *Tribune* has made quite a careful investigation of the paving question in that city, from which we abstract the following interesting details:

In the city of Chicago, out of 277.71 miles of paved streets, there are 213.35 miles of cedar blocks, of which nearly 40 miles was laid last year. It is the cheapest pavement laid in the city.

Dead cedar brought from the vicinity of Green Bay, Wis., was first used, but it was found that it did not wear well, and live timber is now required. The cedar is a tree which does not taper rapidly, and one of good size should furnish a stick 30 ft. long. The logs are brought here by boats in lengths of about 6 ft., with the bark still on, peeled, and cut into blocks 5 ins. long. The blocks range in diameter from 3 to 9 ins., and cost 50 to 60 cts. a yard, measurement being made after they are laid. The process of paving a street with cedar blocks is much the same as was used with the Nicholson pavement. A sand foundation is first provided, and on this are laid boards which serve as stringers. On the stringers planks are placed parallel with the curb and the cedar blocks are stood on end on the planks. The interstices between the blocks are filled with gravel and coal-tar distilled in the manufacture of gas. For the last three years block pavement has cost in this city from $1 to $1.30 a yard. The life of cedar-block pavement is three to seven years, and it is an excellent pavement when first laid. It is believed by many to be detrimental to health from the fact that it absorbs all liquids falling upon it, gives them back in the shape of vapor under the influence of the sun, and is itself constantly decaying. It is a curious fact that this pavement wears out faster on streets where traffic is light than where it is heavy. Cedar blocks are used for paving all through the West, but more freely probably in Chicago than in any other city in the world. They are cheap, and that is a great point in their favor.

Macadam ranks next above cedar blocks in cost as street pavement. Were the macadam pavement seen in Chicago not bound to be very dusty when dry and very muddy when wet it would be an almost ideal pavement. In macadamizing a street there is first spread in the road-bed, 15 ins. below the future surface of the street, a layer of large limestone in pieces 6 to 12 ins. in diameter. This limestone is obtained from city quarries and is bought by the cord, 13,000 lbs. making a cord. On top of the first layer of stone is placed another layer of a smaller size, usually from 1 to 3 ins. in diameter. Then above this is placed a still smaller grade, the stones being about the size of chestnuts. Then there is spread over this a top dressing of granite, and on this is spread a thin layer of Joliet gravel. The road is then rolled with a roller weighing 15 to 20 tons. Macadam pavement is costing this year from $1.50 to $1.80 per sq. yd. There was nearly 1¼ miles of it laid in Chicago last year, and there will be 2½ miles laid this year. January 1 last there was about 28¼ miles of macadam pavement in Chicago, four-fifths of it being on the West Side.

Ranking next above macadam in cost comes asphalt pavement in sheet form. The asphalt used in this pavement comes from the asphalt lake in the Island of Trinidad. A mixture is made of 70 per cent. of sand, 15 per cent. of lime-dust, and 15 per cent. of asphalt, and this is taken to the street in a plastic form. In the street there is first a foundation 6 ins. deep of cement concrete. Upon this is spread a thin layer of the plastic compound, and when that has cooled another layer is spread on top of it, making the asphalt surface 2½ ins. thick. This is smoothed and compressed by a steam-roller weighing about six tons. Sheet-asphalt pavement costs about $3 per sq. yd., complete.

The expense of asphalt in block form, or asphalt blocks, as they are usually known, is no greater than the sheet asphalt, with the advantage of easier repair and a less slippery surface. The asphalt blocks are made of 15½ per cent. of asphalt and 84½ per cent. of crushed limestone. This mixture, while at a high temperature, is run into a press, where it is subjected to a pressure of 85 tons per sq. in. and comes out in the shape of blocks. The blocks are laid on a 6-in. foundation of broken limestone, the spaces between the bits of stone being filled with sand. This is rolled to compactness with a 15-ton roller, and over the surface is spread a layer of fine sand 1½ in. deep. The blocks are laid in this sand on the 4-in. face. They are placed as closely together as possible, and whatever interstices there are are filled with dried sand. Asphalt-block pavement has been in use to a limited extent in Chicago since 1878. It was formerly laid for $2.75 per sq. yd, but the price now is $3.

Granite block pavement is the most expensive laid in Chicago and the most durable. It is the pavement of the future as far as the business part of Chicago is concerned, unless by private enterprise something less noisy is laid, as has been done in New York. A city ordinance provides that nothing but granite blocks shall be put down hereafter in the territory bounded by Twelfth street, the lake, and the river. The granite blocks come in block form from quarries in Wisconsin, Minnesota, Maine, and the Thousand Islands in the St. Lawrence river. They cost the contractors who pave streets in Chicago about $2.50 per sq. yd. delivered on board the cars at the quarries. The foundation for granite-block pavement is 6 ins. of broken limestone flooded with sand and rolled, and on top of this 3 ins. of sand. The blocks are set in the sand, and the spaces between them filled with gravel and tar. Before the spaces are filled, the blocks are rammed with a heavy rammer, a process to which the asphalt blocks are also subjected. Granite block pavements costs from $3.50 to $4.25 per sq. yd. laid.

CORRESPONDENCE.

The Strong Dynamometer Tests.

Lehigh University
BETHLEHEM, PA., Sept. 24, 1887.

EDITOR ENGINEERING NEWS:

In your issue of 17 inst. I am credited with conducting the dynamometer experiments of the Strong locomotive tests. In justice to those who actually did the work please say, that I was in no way connected with this series of tests, and oblige. Yours truly,

J. F. KLEIN.

The Minnesota & Northwestern Tunnel.

Office of Shepard, Winston & Co. R. R. Contractors.
GALENA, Ill., Sept. 13, 1887.

EDITOR ENGINEERING NEWS:

In your issue of Sept. 10th, on page 179, you state that "it is said that the Minnesota & Northwestern R. R. are meeting with such difficulty in an attempt to tunnel a blue clay bluff," etc., that it is proposed to turn it into an open cut. There is not a particle of truth in such a report. It is false and ridiculous in every particular. The tunnel in the first place is through shale and not blue clay. In the second place there is but little difficulty in tunneling this material, and the work is going along well. The only unpleasant feature is, the shale not being sufficiently hard to support itself in the roof, timbering is required, which makes slower work than if it were solid rock. We are working four faces, and can average 100 ft. per month in each face. The tunnel will be finished in January or February next.

By the way if the clay were "proof against pick, shovel and dynamite "how could we "plow and scrape it down to grade?" Respectfully,

SHEPARD, WINSTON & CO.

[We told the tale as 'twas told to us, but as to the last conundrum, there is material which will not pick or blow but will plow and scrape.—ED. ENG. NEWS.]

The Burlington Brake Tests—Correction.

AURORA, Ill., Sept. 16, 1887.

EDITOR ENGINEERING NEWS:

In the hurry of making preliminary report to the Master Car Builders' Association, at the Minneapolis Convention, an error was made in the stops credited to the fifty mixed car train slack shoe test, by which the Carpenter brake is credited with making the shortest stops in General Test No. 5. The Carpenter stops, 1,621 to 1,624, were close shoe tests, coming under General Test No. 2. The Carpenter slack shoe tests were Nos. 1051 to 1054, which gives the shortest stop to the Westinghouse Co.

Yours truly, GODFREY W. RHODES,
Chairman M. C. B. Brake Co.

[The table accompanying this rather important correction is given below.—ED. ENG. NEWS.]

Kind of Stop.	No. of stops.	Name of Brakes.	Speed.	Distance.	Time. From brakes applied by engineer. Rear car. Brake bolts to apply.	Time. From brakes applied by engineer. Rear car. Brake fully on.	Time. From full stop. Brakes off rear car.	Time. From full stop. Train moving.	Time. From release signal until full release, rear car.	No. of cars released by hand.	Train. Total weight, engine, cars and load.	Train. Per cent. braked.	Pressure. Before stop, train pipe.	Pressure. Cylinder, rear car.	Pressure. Brake beam pressure, per cent. weight of empty cars.	Slidometer movement, rear car.	Couplings broken.	Miscellaneous. Brake Casualties.	Wheels slid, distance.
			Mls.	Ft.	Sec.	Sec.	Sec.	Sec.	Sec.		Tons		Lbs. or ins.	Lbs. or ins.					
Fifty mixed slack shoes. Electric.	1351 to 1354	Westinghouse.	30	178	¾	4½	61½	161½	49½	None.	1641	49·3	83	63½		Ins. None.			175
	1051 to 1054	Carpenter.	30	456	1	5	63½	161½	49½	None.	1641	49·3	83	63½		None. ¼ to 1¼			140
Electric.	1431 to 1434		30	228	1	4¼	5¾	37½	1¾	None.	1460	49·6	61	27		1¼ to 2½ 6 to 7			225
Air.	1151 to 1154	Eames.	30	635	1	3¾	¾	46	1¾	None.	1460	49·6	54	24		5¾ to 0	2	Two hose came uncoupled owing to hose too short. In two cars load of wheels had slipped.	450
	1251 to 1254		30	416	1	15	24¾	223½	24	None.	1399	49·8	20½	12					
	1631 to 1634		30	731	1¼	24	31½	570	28	None.	1399	49·8	19½	11					

Average result: Burlington Freight Brake Test, 1887. Stops 1051 to 1054, 1351 to 1354, 1431 to 1434.

NOTE.—Distance corrected for the exact speed noted and for level grade.

Steel Tapes.

FERRYSBURG, Mich., Sept. 14, 1887.

EDITOR ENGINEERING NEWS:

Mr. JOHN L. CULLEY, speaking of steel tapes, in your issue for Sept. 3, gives the *gradienter* the preference, over the stadia, for "truthfulness," and "reliability" in results.

In this he is quite mistaken, for the gradienter, as at present constructed, contains a fallacy not generally known to engineers.

While on the subject of tapes, he should have pointed out the mistake made by all makers, of putting the figures onto the tapes *wrong end up*. By right-handed persons the tape is carried in the left hand, thus leaving the right hand for manipulating a pencil, or chalk, or marker as the case may be—in this case the tape is read from right to left—but in this he finds his figures on the tape all bottom side up.

Mr. K., of Enterprise, Fla., looking for help in information concerning "Wooden Bridges," will find the *Manual* of GEO. L. VOSE, of great service, though that pertains more especially to "combination bridges." Respectfully,

H. C. PEARSONS.

[Our correspondent's point as to the marking of tapes is well made, and it will be well for manufacturers to note it.—ED. ENG. NEWS.]

Call for a Water-Ways Convention.

Yazoo-Mississippi Delta Levee District,
Office of Chief Engineer.
MEMPHIS, Tenn., Sept. 12, 1887.

EDITOR ENGINEERING NEWS:

I enclose a circular call for a convention to meet in Memphis, Oct. 20 next, in the interest of the improvement of western waterways. I saw a notice in your last issue of a similar convention to meet in Peoria, Ill., Oct. 11, in the interest of the Hennepin canal scheme. We made overtures to the movers in that scheme to combine with us and join our convention, for mutual strength, but have heard nothing from them. We hope they will at least send delegates to our meeting and participate with us. We will feel obliged if you will notice our call.

Yours truly, F. G. DABNEY,
Mem. Exec. Com. for Tennessee.

[The call duly appears in our department of Society Proceedings. We are not informed as to the extent to which the two calls referred to cover similar purposes and aims.—ED. ENG. NEWS.]

The Value of a Name.

CHICAGO, Ill., Sept., 1887.

EDITOR ENGINEERING NEWS:

The article on "The Value of a Name," which appeared in your issue of September 3rd, is founded on an entire misconception of facts. Mr. EADS was *not* employed by the Manchester Ship Canal promoters to bolster up their scheme, but he was retained by the Mersey Dock & Harbor Board to give his testimony *against* the Manchester Ship Canal project and to show that the plans of this canal would, if carried out, result in injury to the harbor of Liverpool and to the Queen's Channel. The fee paid him for his professional opinion and testimony before Committees of Parliment was not $20,000, as stated but 3,000 guineas, or about $15,277.50.

The statement made that the real engineering of the works executed by Mr. EADS, "was really simple and what there was of it was carried out by other hands" could not possibly be more untrue. Mr. EADS not only entered into the study of and decided upon all the preliminary details of his work, but from the commencement of the actual work to its close worked out all the problems of construction and decided upon and gave the detailed instructions for the execution of the work to its minutest particulars. This is true of all his important works, the gunboats, the St. Louis bridge and the Mississippi Jetties and also of his last but not completed project, the Ship Railway.

The opinion given by him on the Manchester Ship Canal plans illustrates his habit of studying and utilizing detailed facts in order to bring out important engineering and scientific truths. The facts that he used in this instance had been gathered and laid by during three-quarters of a century, but until his genius turned these dry figures into living forces, no engineer in England had even dreamed that in these musty records were concealed such potent facts. He studied, compared and analyzed them and then by clear and graphical representations, which laymen even could easily understand, he elaborated them and explained their bearing upon the important question at issue and showed so clearly that the execution of the Canal works in the Estuary of the Mersey would ruin it and its important local industries and would decrease the depth of water on the bar at Liverpool, that the Committee decided against the bill and threw it out and compelled the promoters of the canal to make new plans in accordance with the views of Mr. EADS; and yet, the writer of the article says: "Purely professional advice in more elaborate detail could have been purchased for a fraction of the sum mentioned and they doubtless had such already in abundance." The fact is, the opinion given by Mr. EADS on this occasion was not only "purely professional and in elaborate detail," but it is one of the ablest engineering opinions on record.

In reference to the St. Louis bridge the writer of the article again errs. He says: "The actual cost of this novel feat of engineering was about $12,000,000 on an original estimate of less than $5,000,000." The total actual cost of this bridge was $6,536,729.99 and the excess of cost over the estimate was due, largely, to changes and enlargements in the original plans decided upon by the company after the estimate was made.

The writer of the article then says: "His great work in opening the mouth of the Mississippi to navigation was also the result of the possession of other accomplishments than that of pure engineering knowledge alone." If the writer will carefully read the papers written by Mr. EADS on the engineering questions involved in the preliminary study of this subject he will see that nothing but the abundant possession of "pure engineering knowledge" by Mr. EADS led him to complete victory in a fight where he was opposed by an array of talent that to ordinary engineers would have appeared invincible. He proved his case and accomplished his object, not by the possession of a "name" but by the possession of more engineering knowledge and of a greater genius than his adversaries possessed and which gave him a deeper insight into the mysteries of river and harbor hydraulics. It was often asserted during the lifetime of Mr. EADS and now again, as we see, after his death, that his success in engineering works was largely due to his assistants. This opinion was created in part by Mr. EADS himself. He was in this respect, as in others, generous to a fault and he always and everywhere took special pains, and even went out of his way, to bestow credit and praise upon his assistants and to openly attribute his great success to their skill. He often said, when remonstrated with by these same assistants: "My reputation will not suffer by giving you credit for all the valuable services you have rendered in so ably carrying out my plans."

The writer does not desire to enter into any controversy in this matter. The loss of a great friend is still keenly felt by all those who were intimately associated with Mr. EADS, and our grief is too deep to enter into unseemly discussion even for the sake of his good name and great genius; but it is not proper that such misstatements of facts and such unjust and uncalled for insinuations as appeared in your article should go unchallenged.

Yours truly, E. L. CORTHELL.

[Our regret that, from reasons not entirely disconnected with the vacation season, two or three expressions capable of the misconstruction which our correspondent comments should have escaped expunging from a contributed article, is almost balanced by satisfaction at calling out from Mr. CORTHELL, who is of all men perhaps the best qualified to speak authoritatively on the matter, an explicit contradiction of allegations which we have often heard made, and which it is so much easier to make than to refute. We agree entirely with Mr. CORTHELL in admiration of Mr. EADS', genius, although naturally we might not go

so far as one who knew him so long and intimately. His fame may securely be permitted to rest on his achievements, among which we hope yet to number the Tehauntepec ship railway, which, if it should go through, will surely be due to him.—ED. ENG. NEWS.]

The Value of a Name.

EDITOR ENGINEERING NEWS:

Under this head there recently appeared an article in your valuable paper which I am persuaded would not have been published except in your absence. But in the title which the writer employed for his article, he gave the late Capt. EADS the highest compliment words could possibly convey, and went into a very lengthy statement to give substantial reasons why a foreign corporation had sent for him to cross the seas, and paid him an almost unparalleled fee for a mere professional opinion—"the largest professional single fee ever paid to an American engineer." This is no mean praise; especially when the writer esteems it "the value of a name," "famous on both sides of the Atlantic." And when we remember the laborious years through which Capt. EADS struggled in order to gain this name, we may well esteem its "value."

Much of the article was written under a misapprehension of facts, but as no man obtains and *keeps* a great name to the end of a long life without great qualities to back it, the writer has nevertheless paid a high compliment to the good name which Capt. EADS established for himself "on both sides of the Atlantic," as:

> "One of the few, the immortal, names
> That were not born to die."

And for this his friends have to make their acknowledgement.

F. L. H.

Highway Bridge Disasters.

PITTSBURG, Pa., Sept. 19th. 1887.

EDITOR ENGINEERING NEWS:

Referring to the letter of Prof. J. A. L. WADDELL in your issue of 17 inst., it strikes me that his work will not be complete unless he *includes* the names of all the parties who are responsible in any way for a disaster.

If a highway bridge company will build such a close-shaven structure that it will fail under a load of a horse and carriage, then I think the people have a right, and should have a desire, to know the name of the company or of the designer.

If our engineering papers would make a successful effort to publish the names of designers and builders of structures that fail under ordinary loadings I think the effect would be beneficial.

There is no doubt about there being plenty of room for improvement in the designing and construction of ordinary highway bridges and anything that Mr. WADDELL can do toward this improvement will certainly be appreciated by all those desiring to see good designs well executed.

There is not so much need for a new specification, as those of EDWIN THACHER, THEODORE COOPER and G. BOUSCAREN leave little to be desired on this point, as there is for having work designed in accordance with the above mentioned, or other good specifications, and proper persons appointed to see that material and workmanship are both in accordance with those specifications.

FRANK C. OSBORNE.

[There is no doubt that it is for the public interest that the technical responsibility for all engineering disasters should be definitely fixed. So far as this journal is concerned, there should be no doubt that it "makes an effort and a tolerably "successful" one to do so. It is obvious, however, that it is likely to to be impeded obtaining full details of such affairs.—ED. ENG. NEWS].

PERSONAL.

T. WILLIAM HARRIS, contracting engineer of New York City was married on Sept. 15, to Miss EMMA JOYCE.

Mr. J. J. DONOVAN was appointed Sept. 8, Engineer in Charge of the following named roads connecting with the Northern Pacific Railroad, viz.: Helena, Boulder Valley & Butte, Helena, Boulder & Madison, Helena & Red Mountain, Helena & Northern, Drummond & Phillipsburg and such other construction work as may be assigned to him.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—At the meeting of Sept. 21, Col. WM. H. PAINE in the chair, an interesting discussion by Mr. WHINERY of the paper by Capt. HOXIE, U. S. A., on Excessive Rainfalls was read. At Somerset, Ky., Aug. 12, 1886, 1.57 ins. fell in 30 min., four-fifths of it in 20 min., or at the rate of 3¾ ins. per hour. On Aug. 27 of the same year, 1.18 ins. fell in 45 min., 0.95 in. in 30 min., or 2¼ ins. per hour. On May 7, 1882, a very violent rain in Mississippi, lasting 4 hours with 2 hours more of light rain, showed 16 ins., or 4 ins. per hour. The maximum was fully 5 ins. per hour. The fact that the Signal Service had no provisions for observing rate of rainfall was noticed with regret. In the whole service, there is only one automatic registering rain gauge, whereas they should exist at every station. An empirical formula for the maximum rate of rainfall per hour was suggested at 1-12, the annual fall. [The propriety of this was questioned at the meeting, and, we believe, with the greatest justice. We have no belief that the two bear any relation to each other.—ED.]

Mr. COLLINGWOOD described a tremendous fall at Alexandria, La., of 21.40 ins. in less than 20 hours, much of it at the rate of 2 or 3 ins. per hour. Mr. J. F. FLAGG, described a rainfall in the West Indies where a 30-in. tank was filled full and running over in 5 or 6 hours. It produced such a flood in a flat town on the edge of the sea, with streets debouching directly on the water that a woman was drowned standing up and buried in mud so that only the top of her head showed. The water ran 8 ft. deep in the streets. Mr. ANDERSON of the British East Indian service described the enormous rainfalls of 2 to 3 or 4 ins. per hour in parts of India. Col. PAINE described a rain of 1.48 ins. in 40 min. in uptown New York, which choked a cable line with sand.

A discussion of the recently read paper on the Kentucky and Indiana Bridge by J. W. SCHAUB of Montreal was then read, criticising quietly but severely certain doubtful assumptions made in regard to the strains and proportions of that bridge, by which the weight was reduced by a very heavy percentage below that deemed necessary by the late C. SHALER SMITH, while following all the essential features of his design. The details of the criticism we shall endeavor to give more fully later by the aid of engravings, without which they cannot be made clear. The propriety of using eye-bars and built members together in the same member to resist alternating strains was also questioned. The discussion was quite animated but rather desultory.

Mr. EMERY called attention to the violent alternating strains which rails sustain, and thought that certain bridge members were made too large for such strains Mr. COOPER criticized severely LAUNHARDT'S formula, as an absurdity, which no practical engineer would use. Most of those who favored it had not gone back to the original experiments on which it was based, and were mere theorists of little practical experience. After considerable further discussion the usual light collation was served. The building fund is making most excellent progress.

Convention on Improvement of Western Water-Ways.—The following call for a convention has been issued from the office of the Executive Committee at New Orleans, La.:

To the People of the Mississippi Valley: The primary object for which the Executive Committee on the Improvement of the Western Water-Ways was organized, being to aid and encourage continued and united action on the part of the people to have the water-ways improved, and to further the means by which their thought and will may be impressed upon the Legislative and Executive Power of the Government, the people of Memphis, Tenn., through the herein address, have requested a call for a convention, and in view of the need of counsel by reason of the failure of the River and Harbor bill passed by the last Congress to become a law, and by virtue of the power in me vested, I do issue this, my call, for a Convention on the Improvement of the Western Water-Ways, to be held in the City of Memphis, Tenn., on the 20th and 21st October, 1887.

To this Convention, Members of Congress, Governors of States, Members of Legislatures, Mayors of Cities are invited to attend. All trade, commercial, manufacturing, mechanical, laboring, agricultural, river and municipal organizations of the States, cities and counties in the Mississippi, Missouri and Ohio River Valley are also invited and urged to send delegates.

D. B. WOOD, Chairman.
JOHN W. BEYANT, Ass't Sec.

For further information, address W. A. EVERMAN, Secretary Executive Committee of Tennessee, Merchants' Exchange, Memphis, Tenn.

PUBLICATIONS RECEIVED.

Specifications for Steam Heating Apparatus, to comprise Steam Boiler, Brickwork, Radiators, Pipes, Fittings, Valves, etc. Prepared and published in blank form for use by architects, builders, etc., by JOHN J. HOGAN, 87 Centre street, New York, 1887.

This is an exceedingly complete form of specification, with blanks which can be filled in to adapt it to any special requirement. It seems to cover every desired or possible point, and as a labor saving device should be popular with the class requiring such a form either for actual use or for reference.

Report of the Twentieth Annual Convention of the American Railway Master Mechanics' Association, St. Paul Minn. June 21-3, 1887. pp. 211, many tables and plates. $1.75.

This very valuable report is as usual slow in coming out. We shall take occasion later to review it more fully. A very excellent report on Coal Delivery to Locomotives is an especially interesting feature to engineers which we republish nearly in full.

On the Drainage of Lands, Towns and Buildings. By G. D. DEMPSEY, C. E. Revised with large additions on Recent Practice in Drainage Engineering, by D. KINNEAR CLARK, M. Inst. C. E. London, Crosby, Lockwood & Co., Publishers. 1887. 5 × 7 ins., pp. 351.

This is a new edition of the excellent work of Mr. DEMPSEY, with extensive additions by Mr. CLARK exemplifying the more modern practice. The first division of the work is devoted to the drainage of low-lying districts, the embankment and rectifications of rivers, the construction of ditches, pumping engines, and rainfall and percolation. In this connection a number of actual examples are illustrated and described. Under the section main division we have described the methods of draining and cleaning streets, houses and towns. The sewers, means of access, cleaning, proportions and dimensions are treated, and the best available methods of drainage described. This section closes with illustrated description of the main drainage of London, Paris, and many other towns, and the model BY-LAWS issued by the Local Government Board for the use of sanitary authorities are quoted in full in all relating to "New Streets and Building." The work enters very fully into detail and describes and illustrates the appliances adapted to meet particular demands, and gives in many cases the dimensions and cost of construction. It is in a word a most excellent and useful treatise on this important subject, and as the original DEMPSEY is now out of print, we do not know where as valuable matter can elsewhere be found between the two covers of a book.

Street Pavement—Past, Present and Future.

BY JOHN H. SARGENT, READ BEFORE THE CIVIL ENGINEERS CLUB OF CLEVELAND.

The oldest pavement I have examined was laid some 2,200 years ago, and, so far as durability is concerned, little improvement has been made since. This was the famous Appian Way at Rome. It has not been under wear all these years, for it is now buried by the accumulated dust of ages, some feet under ground. In later years, portions of it have been opened up and exposed to view. It was paved with hard trap or porphyritic rock of irregular or accidental dimensions; they have a flat surface and looked like and may have been cracked boulders from the bed of the classical Tiber. Some of them were more than a foot in diameter. These were laid first and the interstices were filled in with smaller ones, so that the joints were broken in all directions.

Another interesting pavement I examined was laid about the year One of the Christian era in the streets of Pompeii. These streets, some of them at least, were very narrow, so that vehicles could not pass each other, so they had to go in one direction. Their cross-walks were stepping stones some six inches high, so that the wheels and animals had to pass between them. Before the ashes of Vesuvius came down and filled them up to the second story of the houses, ruts had been worn into them some 4 in. deep and from 4 to 6 in. wide. I was able to measure the gauge of their vehicles, and found it to be our standard gauge, so *that* came down from ante-Christian times, or, perhaps, from the eternal fitness of things.

The macadamized roads across the Alps are great enduring monuments of the skill and enterprise of

Napoleon Bonaparte. I say enduring, but a macadamized road without constant care and attention would soon go to ruin. These Alpine roads have this care, and besides, little children six or eight years old are constantly on the roads with their baskets and brooms and sweep up the horse droppings, and all else that will tend to keep up the over-taxed soil. I may as well say just here that a macadamized road is, perhaps, the most suitable of any for a country road heretofore tried, but there is hope in a water-tight floor of indurated clay and asphaltum on a gravel bed. More of this farther on.

I remember a very smooth and perfect pavement in Basle, Switzerland. It was made of cracked hard-heads, or boulders, very hard basalt probably. They were laid with their flat or broken side up, and doubtless upon an indestructible bed and filled in with concrete. It was smooth and clean, but it would hardly stand the heavy teaming of our business streets.

The asphalt pavement of Paris in 1867-8 was a perfect roadway in some respects. It was smooth and noiseless; horses were not allowed to wear calks and it was very slippery and hard on them. It required constant attention and got it. As soon as a break was made in it, it was fenced off from the rest of the street and was repaired and ironed to a perfect surface and kept fenced off until hardened. Every night these streets were washed off with large hose rigged on rollers.

Now I will come down to business at home. When the lake water was first introduced into Cleveland we had neither pavements, sewers nor street railways. In 1860, Superior st. was covered from curb to curb with wornout-plank. This we removed after a pretty hard fight, and replaced with what is now called a Medina wet stone pavement. As the cross-section of this street is now a matter of history only, I will describe it.

The gutters were some 12 ft. out from the curb-stone sloping up to the curb; this space was for standing horses and carriages; between the gutters was 66 ft. well crowned, as this form in those days was deemed to give strength to the paving. Twenty years passed and Cleveland had changed from a village in character to a pretentious city. All the level part of the street was occupied by street railway; the pavement had been frequently disturbed to lay sewers, gas and water-pipes, so that the street had become uncomfortably rough. Then the pavement was renewed and the roadway reformed to suit the altered circumstances. A percentage of the stone was fit to relay in the least exposed part of the street; these were used and the balance was laid with new material.

It would, perhaps, be hardly fair, with this experience, to say that with fair treatment the life of a Medina stone pavement is twenty years. But with the increased duty upon Superior St., I will venture the opinion that the present pavement after twenty years wear will be in worse condition than it was when last renewed. Other of our Medina stone paved streets have been renewed and others need it. Some of the streets have stood, I believe, twenty-five years or more. This is a comparatively durable pavement, but it is rough and noisy and hard on horses and carriages. In the matter of roughness, the Medina dressed stone pavement while new has the advantage of being less rough. The wet stone becomes smoother by age, while the dry becomes rougher, especially where exposed continually to the action of horses' calks, as in the street railway tracks. I do not think the dry stone has any advantage over the wet in points of durability and is much more expensive.

About the time of the introduction of Medina stone into Cleveland, and perhaps before, some streets under the hill, and I believe one half of Superior hill, were paved with limestone of like dimensions with the Medina. These proved a failure—they would not stand the weather; if, after being laid three or four years, they were taken out, they would fall to pieces. One side of Superior st. hill was paved with Independence sandstone, from a single layer of flagging near the surface; many of them did good service, but they were irregular in thickness and hardness and in limited quantity. These last and the limestone, I believe, have all disappeared.

About the time of the close of the war, the Nicholson pavement fever broke out. I was one of a committee sent by the council to Chicago to investigate. We took up a block in a street that had been paved some four or five years, observed its condition and wear and reported to the council the facts and gave it as our opinion that if the pavement was well put down with good material it would last from ten to fourteen years, according to the duty asked of it. There was a patent upon this particular form of wood pavement. The holders of the patent went for our council hot and hard, and the upshot of the matter was that the city bought the right to lay the Nicholson pavement in the streets, paying therefor several thousand dollars. How much of it the owners of the patent got has always been a mooted question. Then began the strife for this particular kind of pavement; its cost was considerable more than Medina stone. It is said that sharp practice was used to secure petitions for the Nicholson pavement, and it was hinted that some influential men got their paving for nothing.

How this may be I cannot say; this I know, that some of the streets were paved with very poor lumber, made from dead timber and timber that was unfit for anything else, and the work was poorly done. The result was that the blocks rotted and disappeared in a very few years while others lasted their allotted time of twelve years. A notable case is Franklin st. between Pearl and the Circle. This was paved in the fall of 1869, and the south half of this section has had very little repairs and is a good roadway yet. For some reason, the north half has not done as well and should have been renewed two years ago. The service of the south half—seventeen years—is something remarkable; the blocks have not rotted, simply worn out. But the patent was expensive and not good. A far better and cheaper wood pavement is cedar poles cut into 8-in. blocks and bedded in good gravel without boards under them. Madison st., Toledo, was paved in this manner with red cedar from Tennessee, and has now stood quite a number of years without repairs, and has, as I believe, in no wise failed.

Upon streets with business enough to wear them out before they rot, white cedar would do as well, say for ten or twelve years, while the cost is not one-third of Medina stone pavement, and carriages and horses and their shoes will suffer much less on them than on the stone. These white cedar blocks are quite popular in Detroit and other Michigan towns. This pavement is so simple in construction that its renewal is made with little interruption to travel. As a question of economy let us compare the Medina dressed block with the white cedar block as a basis. We will assume the stone block to cost $3 per sq. yd., and to last thirty years, and the cedar block to cost $1 and last ten years, and that the city issue 4 per cent. bonds to do the work. The sinking fund to redeem the bonds would be 10 cts. per annum per yard in both cases, with reinvestment something less. Now in the case of the stone, the city pays for the stone pavement 12 cts. interest plus 10 sinking fund equals 22, and in the case of wood 4 cts. interest and 10 sinking fund equals 14 cts. Hence, so long as the relative cost remains the same it will cost scarcely two-thirds as much to keep a street paved with cedar blocks as with Medina dressed stone.

There is a sanitary consideration to be taken into account as between wood and stone. As soon as the wood begins to decay it fails, and will have to be renewed; until then there is nothing unhealthy about the wood; hence the great importance in putting down sound timber.

All the complicated patent arrangements and preservatives applied to wood in pavements are worthless, and only serve to swell the cost; the simple block set in good sand or ballast is all that is wanted. There may be some better kind of pavement timber than cedar, but it has not yet been found. I do not wish to be understood as advocating wood pavements for Cleveland, for the supply of cedar will give out, and its cost will enhance; but I wish to give all kinds of pavement all the advantages they can justly claim.

Preparations of asphaltum have not so far been a success in Cleveland; their composition is too uncertain and requires too much attention to be trusted in the hands of an ordinary board of improvements. The asphaltum as a top dressing combined with sand, and as an article for filling in the joints of stone and brick, and perhaps wood, is no doubt valuable. For sidewalks, an artificial stone or concrete makes a better and more enduring material than our sawed and split sandstone, but it will have a hard fight to compete with it in cost. Broken stone, slag and cinders for city streets are little better than the natural soil.

In conclusion, I wish now to treat of a material for pavement with which we in Cleveland have had little experience. It is so abundant, so accessible, and so cheap withal, that people discard it as but the dust beneath their feet. So it is with many of the most common things in nature; they often turn out to be our greatest blessings. Petroleum and natural gas took many years to demonstrate their capabilities. Clay, the ore of aluminum, when properly manufactured and burned, becomes what may be called an igneous rock, unaffected by the weather, water, or fire itself. It will stand more pressure in the testing machine than the best of granite. It is homogeneous and slightly elastic; it will neither act upon the horses' shoes nor be acted upon by them. I speak now of brick made of fire-clay. They should be burned hard enough to partially vitrify the molding sand on their surface. In this condition you cannot sharpen your axe upon them, nor wear away their surface by attrition. The tenacity and wearing quality of an ordinary brick is remarkable. The mason, when he has to shape a brick, will not attack a hard burned one; if he does, watch him, and see how little effect he has upon it with his sharp steel trowel. Look at our tall brick buildings, and see what pressure ordinary brick have to sustain. The walls of my own homestead have stood the buffetings of sixty alternating seasons of frost and heat and storm unimpaired. The bricks of the old Roman ruins, shattered by earthquakes, fire and war, stand out sharp and jagged; these bricks are but 1¼ ins. thick, but they, the individual bricks, are now as sound and solid as they were two thousand years ago.

It is thought that the fire clays of our coal measures will produce a better brick for pavements than our common red clays. I am inclined to think this is so, but the common brick have been used in Charleston, West Virginia, and Bloomington and other towns in Illinois for a dozen years. Some taken up after ten years' wear had been worn down less than a quarter of an inch. Experience only can determine the best clay and best treatment. Last fall a small section of fire brick was put down in the street railway track at the intersection of Detroit and Pearl Sts., and another at the intersection of Ontario and Michigan. I would invite the members of the Club to examine them. I can see no perceptible wear or deterioration. Aside from the question of durability and economy they make a very smooth, quiet and dustless street. There are certain patent schemes for brick pavement, but they are all "no good," and come under the same category with patents on wood pavements. A perfectly formed and consolidated roadbed made by rolling or pounding and covered by a single course of bricks laid edgewise with the joints filled with hot asphaltum and sharp sand makes a perfect, continuous floor, on a foundation that cannot escape.

The only pavement that can now come into competition with this in Cleveland is the Medina sandstone pavement. We will now examine this material. The Medina sandstone is a very compact and hard sedimentary rock. All sedimentary rocks are, however, laminated, and have a cleavage parallel to the beds, and they are laid in the pavement in a way favorable for the horse calks to act upon them. As a result, observe the stone in the railway tracks in Superior street and on the Viaduct, and you will see the dressed stones converted into boulders as rough as any well-laid boulder pavement. There is another cause for the wearing away of a sandstone, however hard it may be; it is composed of silicious particles that will "bite" iron and steel. The same force that acts upon the shoe reacts upon the stone. The grindstone cuts away the steel tool, but the tools ultimately wear out the grindstone. Clay or brick has no grit that will bite steel, and on that account will not be reacted upon by the steel; so they cannot destroy each other. From my observations I believe a brick pavement can be made to outlast in good condition a Medina stone pavement, and will cost much less; how much less we shall soon see. If it should be found on investigation that the fire-clays are the most suitable for pavement they exist in great abundance within easy access to Cleveland by canal and rail.

The chemical constituents of the clay should be taken into account. It is clay that gives the hydraulic quality to the water limes. The physical qualities of fire clay may be divided into the hard and the soft plastic, but not differing greatly in their chemical constituents. Singularly enough, the plastic has less combined water and alumina and more silica than the hard. On this account I should expect the hard to make the better brick for paving. Lime, uncombined at least, would probably be deleterious. Here is a specimen of the hard variety from New Cumberland, W. Va., on the Ohio river. There it is burned with natural gas in down draft kilns or ovens. They may be burned in the same kind of oven with slack coal to any degree of hardness required, as they are in Tuscarawas county. One happy circumstance is that the bricks too soft for pavements are better for furnace linings than the harder ones, and worth quite as much.

Individual residents of Franklin avenue, being in West Virginia, observed some of these brick pavements, some that had been down three years, some twelve, and were struck with their smoothness and good condition. A public meeting was called and a committee was appointed to gather information. They went to Wheeling and examined the pavement, and to New Cumberland to examine the material and its manufacture. The committee was very favorably impressed, and reported advising the use of fire-brick for Franklin avenue—here are several letters received by the Committee which the Club would perhaps be glad to hear read; if so, I will ask Mr. HOLLOWAY to read them.

The Board of Improvements has advertised for proposals for both brick and Medina dressed stone pavement. When these bids are opened we shall be able to see the relative cost. If the specifications prepared for the brick pavement by the board have no unnecessarily expensive requirements, I shall expect the brick pavement to cost little if any more than one-half the stone. At the same cost, and I have a long front to pave, I should much prefer the brick. The cost of a foundation for the one is practically the same as for the other. The brick will have a more perfect bearing than the stone, for the bricks have a full bearing bed all alike, and are of the same depth, while the stone are of unequal depths, and the lower end more or less wedge shaped. The bricks will fit far closer together, and hence will require much less asphaltum filling, and having a smoother surface will shed off the water more perfectly.*

DISCUSSION.

At the close of this paper, the following letters were read:

Mr. HOLLOWAY first stated that these letters were replies to inquiries made with the view of going to the root of the matter, and were written by persons who had no interest in pressing the claims of any pavement

A. H. BELL, City Engineer, of Bloomington, Ill., stated that the citizens were highly pleased with the brick pavements. The bricks are ordinary clay brick burned very hard—almost vitrified. Where there is no grading or foundation to prepare, the pavement costs $1 15 per sq. yd. laid down.

P. WHITMER, of the People's Bank, Bloomington, stated that since Bloomington had tried brick pavements, Galesburg, Jacksonville, Champaign and other cities had adopted brick, and all were pleased with it. In Bloomington, an inch of sand was first put down, then a course of brick, laid flat, on which was placed a thin layer of sand, then a course on edge as close as convenient, say a quarter of an inch apart. On top of that enough sand to fill the interstices, and it is done.

Mr. HOLLOWAY stated that the city engineer of Bloomington had read a paper before the club in Chicago in which he spoke highly of the brick pavement in use in Bloomington. I think they lay double courses there on account of the clay soil, with the idea of getting more surface.

The "Riverside Steel Co.," of Wheeling, W. Va., stated that the citizens were so much pleased with the brick pavements that they were being used to the exclusion of every other kind. Those laid three years ago do not show any appreciable wear, and they do not become smooth and slippery in winter. They are almost noiseless, and are easily swept and kept clean. The drainage is quick and complete. The pavements can be built at a cost of $1.60 per sq. yd., which includes all material and labor and preparing a bed to receive the substratum of gravel or sand. The blocks are 9" × 3" × 5", and weigh 9 lbs. 10 oz. each.

J. M. DODDRIDGE & Co., of Wheeling, W. Va., stated that the Board of Public Works had put down over three miles of fire-brick pavement, and would continue to put it down on all streets needing improvement.

Delegations from Columbus, Zanesville, Pittsburg had been at various times at Wheeling, with regard to this subject, and fire-brick is being tried in those cities.

A. LAING, of Wheeling wrote that an experimental street paved some years ago with brick looks as good as new.

J. P. HALE, Charleston, W. Va., stated that the clay used for paving brick was simply a good quality of common building brick clay, tough, stiff and tenacious. Such clay could be found in the vicinity of almost any city in the United States. The writer believed that brick would eventually supersede every other material for street paving. In his opinion it is not only the cheapest, but the best material that can be used.

Prof. I. O. BAKER, of the School of Civil Engineering, Champaign, Ill., stated that the cost of brick pavement varied there from $1.60 to $1.87 per sq. yd. according to the freight on brick or sand. It had been tried 3 years and no sign of wear could be discovered. For method of laying Prof. BAKER referred Mr. HOLLOWAY to an editorial, in ENGINEERING NEWS, Vol. XIV., page 330, Nov. 21, 1885.

W. MCD. HILLER, of Steubenville, O., said that a test square of vitrified fire-brick set on edge was put down three years ago, and had not cost a cent for repairs since. Parts of several streets are now being paved. Some blocks cost as little as 85 cts. per sq. yd., including everything. Others cost more because the excavated materials have to be hauled further, and because there is not a natural foundation of gravel; but all cost under $1. The hard-burned red-brick stands five tons pressure; the new Cumberland fire-brick, eighty tons pressure. It is smooth but never slippery; horses never slip on it in winter.

The prospectus of the "Hale Pavement Company," of Staunton, Va., containing a large number of testimonials from various cities, was referred to by Mr. HOLLOWAY. This company claim that their pavement is durable and serviceable, economical, clean, healthful and comfortable and noiseless. The material for the pavement is, first, sand, then boards dipped in hot coal tar, then hard-burned brick.

Mr. HOLLOWAY: Last fall, in Allegheny, I saw a street paved with fire-brick. The street has residences on one side, and on the opposite side there are terraces sloping down to the depot. The first thing that struck me was that they were laying courses of brick flat ways. I asked a gentlemen why they did not set them on edge. He replied that they were trying an experiment. I said that I supposed that they would have put lower courses of good red brick. He said that there was not much difference in the cost. A gentleman who was passing stopped and said that the way in which this was being laid down would not answer. The agreement was that they should have just such a street as the block above From what was said afterward, I gathered that the people were very much pleased with the paving of the block mentioned, which had been laid over a year. I walked then to the block above. It was very clean. I did not see a broken brick or a soft brick in the whole street. While I was there a great many teams passed. It was a little down grade, but they never halted, showing that the horses had confidence in it. I listened for the sound of the wheels. I could hear the click of the horses' feet on the pavement, but there was no rumble of wheels. It was almost noiseless.

Mr. H. M. CLAFLIN: As to Medina stone, I could read a number of letters giving favorable criticisms, but I do not wish to put myself in the light of a patent medicine vender. The people in Bloomington have no stone. The brick pavement is a great improvement upon the mud. So with the other little towns. What do the people in Harrisburg know about pavements? Of all the slow-growing places in the world, Harrisburg will take the palm. When you go to cities that are cities, do you find them adopting fire-brick, or any other brick? I saw in San Francisco one street paved with brick. It is the only street, so far as I can learn, ever paved there with brick. Brick was put down in Chicago and has been taken up. In St. Louis they went to great expense and tested all sorts of pavement. Did they adopt fire-brick? No, they adopted granite. The City of Toledo was about to pave one of its streets. A fire-brick man tried to induce the people to adopt his pavement. I went up there, and last night the contract was awarded me. The Topeka people have tested all kinds, and have declared against fire-brick, and have adopted stone and asphalt. I am going to lay it down as my creed that an artificial pavement, if any other can be had is a very foolish device. When the material is subject to the action of the weather, horses' feet and so forth, the artificial pavement may not be enduring. The only material practicable for pavement is stone. When you lay it well you get the best results. Mr SARGENT compared wood with Medina stone. He placed the lasting qualities of Medina stone at thirty years and those of wood at ten years. If you look at any street paved with wood that has been down for ten years, you will see that it has been down at least three years too long. I can show Mr. SARGENT a street where the stone was laid down fifty years ago. I want to ask, as an engineering problem, how long a street laid with block pavement will last? River St. was laid thirty years ago. A year ago last summer we took up a part and relaid it. If any one will examine it he will see that it is one of the prettiest pieces of pavement to be found, though it was laid in an unmechanical manner. You can see Medina stone in your own city. In Buffalo you can see 100 miles of streets paved with it. It is as lasting as granite: it is not as noisy nor as slippery. You can saw and polish granite, but you cannot saw nor polish Medina stone. I examined some granite laid on Fifth avenue. It is laid much like Euclid avenue block stone pavement, but it does not begin to compare with the block stone pavement laid in Cleveland.

Mr. WHITELAW: In Omaha they are using a pink granite.

Mr. SARGENT: I do not think there is any stone equal to the Medina stone for pavement.

Mr. WHITELAW: Mr. GORDON LLOYD laid down a good deal of brick in livery and other stables. His process was to heat the brick and dip it in coal tar. He said this made it impervious to water and to frost.

Mr. SARGENT: A car-load of bricks was put down in Pearl St. and one at the corner of Prospect St. There was a top dressing of hot asphaltum. I cannot see that there is any wear in it.

Mr. CLAFLIN: My conundrum is this—How are you going to say whether fire-brick is soft or hard.

Mr. SARGENT: You cannot always tell about Medina stone. Bricks do not require to be burnt so long for livery stables as they do for paving. I have had nothing to do with fire-bricks except with these two car-loads. Perhaps when fifty years go by we may know as much about brick pavements as we do now about Medina stone. A short time ago the use of gas and petroleum was thought detrimental, now we could hardly do without them.

Mr. HERMAN: In my native city, Prague, there was experiment made in 1857. A block in a street was paved with brick in herring bone style. The city is paved even to the narrowest alleys. After considerable agitation a permit was obtained to lay a block with this brick pavement. It was taken up in a year as unfit for the purpose. Brick is used extensively in this city for paving floors. The bricks have to be frequently replaced. I notice here some sidewalks paved with brick, and I often stub my toe on them. In Akron I found a number of pavements with tiles vitrified, and tiles are used in this city in driveways on Euclid avenue. I see that many of them are destroyed.

Mr. HOLLOWAY: The question is interesting to every one. Sewerage and pavements are among the most important unsolved problems. I am not one of those people who are in the habit of running after a new thing. The proper material for paving the streets of a city has been spoken of as if the streets of a city were different from streets elsewhere. There are in all cities streets which have to bear nothing heavier than the grocer's wagon and the doctor's gig. Because the main streets of a city require enduring pavement, that therefore the question of endurance is to be the only one taken into consideration is preposterous. While I am prepared to say that the recently laid pavements of Medina stone are very fine indeed, I am not prepared to say that it is the only material for pavement. The question of living on a quiet, smooth, clean street is to be considered. One idea in the introduction of the wooden pavement, was to have some rest from the noise of the rough stone streets. A stone street is an undesirable one for private residences. People who have lived on Pearl street have been obliged to leave it on account of the noise. There is hardly a public building in this city where you can listen to an address with any degree of comfort on account of the noise of the stone pavement. For my part, while I have great respect for posterity, I think it can be proved that streets lasting 15 years may be renewed with greater economy than those lasting 50 years. I am not prepared to say that the most enduring material is in every respect the best for the purpose. It has been demonstrated that brick is the best for all building purposes. Costly buildings of stone in Chicago were blistered and burned almost beyond recognition.

I have not said anything in disparagement of the excellent stone streets that we have had for years, but I believe that there are miles of streets that have but little traffic on them, and if they can be made comfortable, cleanly and wholesome by the use of fire-brick, or any other brick, it will be a benefaction to the people of Cleveland. There are miles of streets that should be paved with stone. I know that the main street of Wheeling is a street of heavy traffic. It was filled with four and two horse teams hauling the heaviest kind of material. I have no interest whatever in this matter beyond that of living in a quiet residence street.

* Since this paper was read, the dressed Medina stone pavement in the street railroad tracks on the Superior street viaduct, laid in 1879, have been taken up and relaid. Nearly all of them had to be redressed and a notable percentage of them replaced by new stone, while the brick pavement laid in the same tracks at the Detroit street crossing last fall, show little or no signs of deterioration.

Mr. CLAFLIN: There is one thing that I would like to say: in all these comparisons of costs there has been unfairness of representation. They propose to put down firebrick about 4 in. in depth. In Medina stone they use 7 or 8 in. It has been represented to the people that they could get a pavement for $1.20 a yard. In Columbus the price was $1.80 per sq. yd. In Toledo it was $2.25. Medina stone dry pavement is about $1.80 a yard.

Mr. HOLLOWAY: I do not know what the cost of this material is. In regard to the depth of the material, I think Mr. CLAFLIN is very modest in his statements. I have seen stone pavements here over a foot in depth. In times past very little care was taken as to the shape of the stone. One of these advantages in brick is that it has a perfect bond. The ends are supported by each other and the sides are supported by the adjoining brick. Where all is held by the abutting brick, there must be additional strength to the whole. The effect of any pavement that has joints in it is that the calks of the horses' feet will break off chips. When the pavement was laid upon the viaduct it was smooth, now it is very rough. It has been worn where the horses' feet strike till the stones look like old cobble stones. The other part of the road is smooth, but smooth at the cost of the material below. I think that any material which presents few or no joints, few or no parts for the calks of the horses to break off the edges is advantageous.

Mr. CLAFLIN: When the pavement was laid on the viaduct it was the first work of the kind laid here. The stone was not even gotten out by expert men. The pavement going up the hill is to-day one of the finest pieces of work that I have seen. It is true that the stones in the tracks are worn off a little, but I should like to have any one discover a material to put in a street railroad track that will last when it has been down ten years. That on the sides is not so much worn. The shoes of the street car horses are kept much sharper than those of ordinary horses. If you account for the smoothness of the sides from the fact that the stone is worn down I think you make a mistake. I would like to show the pavement going up the hill to any man in America to-day as a piece of first-class work.

Mr. SARGENT: I want to say a word about the much-abused wood. They say in Detroit that wood will last about ten years. In 1869 a street on one side of my residence was paved with the Nicholson pavement. It is quite a good piece of road yet. I had no idea that the material could last so long. On the other side is Medina stone pavement, and on Pearl St. it is a very hard to hear your neighbors. Now Pearl St. has a great deal of business, and it is possible that such streets require a stone pavement, but I would rather have such a street as Franklin Ave. laid with cedar, on account of its noiselessness and cleanliness. In Wheeling I did not see any streets that were broken. I have always been a great advocate of the Medina stone pavement. I think it is superior to any stone pavement, unless it be the basalt pavement.

Battle Creek Station Specifications.

The Battle Creek station, which was illustrated in this journal last week, is completly described in all its minor details in the specifications below, which, as it is one of the fullest, most recent, and most carefully drawn of its kind, we reproduce nearly in full for the convenience of our readers. There is a building, we may add, not shown in our last week's engraving, 60 ft. to the left of the main building, containing baggage and express office, boiler room, and men's water closets. The stone foundation of the main building is 5 ft. deep. The main heights are as follows:

Ceiling of waiting-room	16 ft. 4 in.
Ridge of roof	32 " 2 "
Top of tower walls	60 " 0 "
Apex of tower roof	72 " 0 "

SPECIFICATION.

Excavations.—Excavate under whole of both buildings to the depth of 18 ins. below the bottom of floor joist. (Further details omitted.)

Foundations.—Bail or pump out all soil or water that may fall into trenches. Build all foundation walls depths, heights and sizes shown, of good rubble masonry, well filled with cement mortar, and well bedded on same, to show a good smooth and plumb face. The footings will be made of No. 1 large stones, free from cracks, flaws, or breaks, and well bedded on their natural bed. Around all the principal walls there will be two footing courses, the minor walls, including walls of baggage house, to have one. These footing courses will each project 4 ins. beyond wall above, except those for walls of tower, where the projections will be 6 ins.

All rubble foundations will have large headers extending through wall, at least one to every 20 sq. ft. of wall.

All foundations will be laid in mortar made of 1 part imported Portland cement, and 4 parts clean sharp sand.

Openings wills be left in walls for drains or waste pipes, so that mason work will stand 2 ins. clear of all pipes. Openings will be left where directed for ventilating space under floor. Leave openings at ends of trenches made for heat pipes.

BRICK-WORK.

All the exterior walls above the grade course, all interior walls, chimney breasts, piers and all walls colored red on the plans and sections, will be built of the sizes shown, with hard, burnt bricks of the best and hardest cull.

All cross walls of main building will run up, to support purlins of roof. To stiffen the 4-in. brick wall on each side of stair case to telegraph office, there will be studs set upright, and the bricks set built in between the studs.

All the outside walls of both buildings will be faced with Detroit best hand-made stock bricks, carefully laid to give a true and plumb face. Inside the different rooms of baggage house, the brick work will have joints cut smooth and flush. No soft or salmon brick will be allowed in building.

Fill in between the walls of vestibules and halls, to be tiled, with two layers of brick and cement mortar as a bed for the tiles.

The boiler room will have a floor of 4 in. thick Euclid blue-stone, bedded on cement and the joints run with grouting.

Arches.—Bricks for the large exterior arches to be 12 ins. long, and the lower edge of inner ring on all exposed corners to be rounded. These arches will have label as shown, with dentel and one projecting course above. Over outside window to ticket office, turn an arch with three rings of 8 in. bricks. Over the large interior openings, turn strong arches of three 8 in. rings. Turn double rowlock arches over all the smaller openings of interior walls, over the inside of window and door openings having dentels outside, and elsewhere necessary. Turn a strong trimmer arch for fire-place and relieving arch over fireplace lintel. All arches will be properly bonded as directed.

Fireplace.—Lined on face and inside, not specified for fire-bricks, with best selected board hand-made stock bricks. The back of fireplace (but not the sides or the fire dogs) for a distance of 4 ft. above the hearth, will be lined with best make fire bricks laid up in fire clay.

Chimneys.—The boiler flue will be square, with joints struck smooth on inside and not plastered. The fireplace flue will be through two 12-in salt-glazed earthenware pipe, built in the brick work, with joints carefully set in cement and brushed out with damper in bottom of one flue. The boiler flue will have at lowest end a cast-iron flue door built in wall.

Bond.—All brick walls, together with chimneys, etc., will have every sixth course a heading course going through wall. All face brick work will have every sixth course bonded with alternate header stretchers.

All bricks will be well wet during warm weather. Make chases or slots for heating, and ventilating and plumbing pipes where shown.

Damp Proof.—There will be on top of all exterior and interior foundation walls at level of bottom of grade course a heavy coat of hot asphalt and bedded in this a layer of two ply ready roofing, tarred paper, laid lapping ends and completely covering the walls.

(TO BE CONTINUED).

CONSTRUCTION NEWS.

Water.

Sale of Franchise.—The attention of water works Contractors and Capitalists is called to the advertisement on the front cover page, of a Water Works franchise for sale. The party selling is a well known builder of water works, of unquestionable reliability.

Carlyle, Ill.—The water works have just been completed. There are 3¼ miles of pipe and duplicate pumps of the DEANE make of one-half million gallon capacity each. Head is afforded by a steel stand-pipe 10 ft. diameter and 115 ft. high. The plant was built by the Water, Light & Power Co. of St. Louis, Mo.

Manitowoc, Wis.—Water-Works for this flourishing little city are again advertised. (*See Front Page Cover*). Bids were received in January last but they were unsatisfactory. This time the city presents definite plans and all bidders stand upon an equal basis. Manitowoc is growing in population and wealth and among recent improvements the extensive coal docks of the Hocking and Columbus Coal Co. has added immensely to the shipping facilities of the place.

Pine Bluff, Ark.—Work is being pushed on the construction of the works. The supply is taken from a vein 93 ft. underground. A large masonry well will be sunk to the water bearing stratum and the pumping machinery will be placed in a pit. The pumps will be duplicate, each with a capacity of 1½ million gallons. Steam will be furnished by two 75 H. P. tubular boilers. The pumps will force directly into the distribution, and head will be given by a steel tank 32 ft. diameter and 40 ft. high placed on a stone tower 70 ft. high. About 9 miles of mains will be laid this fall. The contractors for the work, are the Water, Light & Power Co. of St. Louis. F. W. RAEDER, is Engineer.

New Water Works.—*New England.*—The Vineyard Haven Water Company has been organized by Boston capitalists to build water works at Vineyard Haven, Mass., at a cost of about $40,000. FRANCIS PEABODY is interested.

The Stony Brook extension of the Cambridge, Mass., works is nearing completion. The new gate house is 31×25 ft., built of faced brick with granite base, and trimmings of yellow New Brunswick freestone.

The Barre (Vt.) Water Company has let the contract for building the works to Goodhue & Birnie of Springfield, Mass., to be completed July 1, 1888. The town is to have the option of purchasing the works within 60 days after their completion at an advance of 10 per cent on their cost.

New York.—The Herkimer Board of Water Commissioners have chosen W. B. HOWELL, President, and CHAS. SPINNER Secretary, and will enter at once upon the work of construction. The water will be obtained from driven wells, and hydrant pressure will be used for fire streams.

A survey has been made for a water supply system for the town of Westfield. The cost is estimated at $50,000.

Water-works are under construction at Greenbush and Waterville, and will be built at Sanford, Tarrytown and Phœnix.

Maryland.—J. B. Cloud & Co., of New York City, are to build water-works for the town of Salisbury at an expense of $25,000. The supply will be taken from the Wicomico river.

Indiana.—The supply for the works at New Carlisle has been increased by driving a number of new wells and connecting them to the supply main.

Illinois.—An artesian well is to be put down at Jerseyville.

An election will be held at Tuscola, October 1, to vote on the question of expending $26,500 for water-works.

Works are to be built at Sycamore, Joliet, Lostant and Cabery.

Wisconsin.—The Union Grove Water-Works Company has been organized to construct works at an estimated cost of $5,000 for Union Grove, Racine county. JOHN DIXON is interested.

Minnesota.—Work is progressing on the extension of the distribution system at St. Cloud.

At Mankato a reservoir of one million gallons capacity will be built at a cost of $4,550. Two thousand, three hundred feet of new main, will be laid to connect the reservoir with the distribution.

The town of Hayward has voted to spend $12,000 in establishing a water-works system.

The works at Austin are under construction and will be finished December 1. There are to be five miles of mains.

Iowa.—At Marion $25,000 worth of mains are to be laid this fall.

Works are to be built at Dunlap at a cost of $10,000.

Nebraska.—Fifty wells have been driven to give an additional supply for Lincoln.

A company has been organized to build works at North Platte.

Kansas.—The contract for the works at Greenleaf has been let to E. SUTPHEN, of Clyde, Kan. The Deane Steam Pump Company will furnish the pumps.

Missouri.—The bill for the extension of the St. Louis works has passed the City Council and been signed by the Mayor, much to the relief of those interested in the city's supply.

The City of Lebanon, has granted a 99-year franchise to the Lebanon Water Company, provided they construct the works within one year. A 1000-ft. artesian well has already been put down.

Dakota.—The works at Bismarck are being pushed in order to finish the work before cold weather.

Idaho.—The works at Bellevue will be put in operation October 1.

Washington Territory.—It is proposed to build works at Ellensburgh.

Georgia.—The capacity of the pumping machinery at Savannah has been increased to seven and one-half million gallons. This is at the rate of about 250 gallons per capita.

Alabama.—The new system of water-works for Mobile has just been completed at a cost of $685,000. There are 10 miles of 24-inch mains and 25 miles of smaller mains. The supply from Clear creek is 30,00 ,000 gallons per day and an auxiliary supply of 60,000,000 gallons may be obtained from Red Creek.

Louisiana.—It is proposed to make extensive improvements upon the plant of the New Orleans Water-Works Company by the construction of filtering beds, a settling reservoir or mechanical filters. JAS. D. HOUSTON is President.

Texas.—Ninety driven wells are to be put down at

Fort Worth, which it is estimated will furnish a supply of 3,000,000 gallons daily.

The City council of Corpus Christi will issue $40,000 of bonds for building a new supply.

Mexico.—A complete system of water-works is to be established at Chihuahua. Sealed proposals have been called for to close October 13.

Norfolk, Va.—The City Council has let the contract for a water supply to the Suffolk & Portsmouth Water Company, the work to be completed by October1, 1888.

Washington, Ga.—The town council has appropriated $10,000 for building water works.

Seymour, Ind.—At the special election the proposition to build works was carried by a large majority.

Pawnee City, Neb.—Bonds to the amount of $38,000 have been voted for water works and bids are to be called for at once.

Gallatin, Tenn.—A Board of Trade has been organized with ROBERT BEEBE as President, and water works of various systems are being discussed.

South Pittsburgh, Tenn.—A charter for a water company has been obtained. JAS. L. GAINES is interested

Illinois.—Water-works are contemplated at Morrisonville, Mount Carroll, and Collinsville. At Macomb an artesian well is in progress, the projectors of which hope to strike either water, coal, or gas.

Water Waste.—At Troy, N. Y., the report of Superintendent BAERMANN shows 920,000,000 galls. pumped in the first six months of the present year against 916,000,000 for the same period in 1886. He thinks these figures show that a single inspector can do but little toward stopping waste, to which he attributes the increase in consumption.

The Shone Hydro-Pneumatic Sewerage and Water Supply Company, of Chicago, has been incorporated by CHESTER B. DAVIS and others to execute works upon the Shone system and manufacture supplies.

Sewerage.—*Chattanooga, Tenn.*—The Board of Public Works have made a report to the City Council on the sewer improvements and extensions that should be undertaken during the current and coming year. The following is the estimate of cost of the proposed work:

Estimate of the Cost of the Proposed Sewers.

22,282 feet 8-in. pipe sewers, at			.60	$13,369.00
9,115	" 10-in.	"	.70	6,380.50
3,200	" 12-in.	"	.85	2,720.00
1,930	" 15-in.	"	1.10	2,123.00
3,733	" 18-in.	"	1.30	4,853.90
8,835	" 24-in. brick	"	1.50	13,252.00
1,130	" 30-in.	"	1.90	2,147.00
3,230	" 36-in.	"	3.25	10,497.50
25 catch-basins		at	75.00	1,875.00
400 manholes		at	35.00	1,400.00
100 lampholes		at	6.00	600.00
Total				$59,203.90

Massachusetts—Ware.—E. C. DAVIS, of East Hampton, has submitted plans for a system of sewerage, the estimated cost of which is $35,000. The work will probably not be undertaken until Spring.

Northampton.—The alderman have voted to adopt the "Shedd" system of sewers. It is estimated that the expense of the whole work will amount to $480,000.

Revere.—The Beachmont Improvement Society has been considering the matter of sewerage. The irrigation system it is estimated would cost about $60,000. A committee has been appointed to investigate the expense of different systems. Dr. J. S. SHAW is Chairman.

East Orange, N. J.—Work on the system is about two-thirds completed, and it is expected to have the whole work in operation by December 1. C. PH. BASSETT is Engineer.

St. Paul, Minn.—City Engineer ANDREW RINKER has made estimates of next year's sewer work and assessments. The proportion to be assessed on the property benefited is $122,964.94 and the proportion to be paid by the City is $117,627.43, making a total expenditure for the coming year of $240,592.37.

Proposals Open.

Stone-Crusher and Road Roller.—One ten ton steam road roller, stone crusher and engine. STREET COMMITTEE, Lancaster, Pa. October 3.

Sewer Work.—*San Diego, Cal.*—Digging and backfilling sewer trenches over that portion of the entire sewer system not already under contract—about 140,000 lin. ft. BOARD OF TRUSTEES. October 6.

Ansonia, Conn.—Brick sewers 1,874 ft. Pipe sewers, 4,475 ft. Office of BOARD OF WARDEN AND BURGESSES, September 26, 8 P. M.

Albany, N. Y.—Vitrified stone-ware pipe drains in Robin street. BOARD OF CONTRACT AND APPORTIONMENT. October 3.

Railroad.—*Nova Scotia.*—On Oxford & New Glasgow branch of Intercolonial Ry. DEPARTMENT RAILWAYS AND CANALS, Ottawa. October 10.

Levee Work.—BOARD OF STATE ENGINEERS, New Orleans, La. October 1.

Engineering Work.—Plans and Specifications for improving Rio Grande river at Alamosa, Col. $250 to be paid for plans adopted. STATE ENGINEER'S OFFICE, Denver, Col. October 15

Water Works.—*Sumter, S. C.*—Erection and maintenance of complete system. 50 hydrants, four miles of mains. C. M. HURST, Village Clerk.

Filtration System.—At Beatrice, Neb., plans and specifications and bids for construction in accordance therewith. Three plans for capacities of 600,000, 800,000, 1,000,000 gallons per 24 hours. W. A. WAGNER, Water Commissioner. October 1.

Flexible Main.—Furnishing and laying a flexible joint water pipe with meter attached, from Brooklyn to Governor's Island, N. Y. Captain J. H. LORD, Governor's Island, N. Y., October 7.

Street Work.—*St. Paul, Minn.*—Paving two blocks on Sibley street; grading on nine streets. THE BOARD OF PUBLIC WORKS.

Cleveland, O.—Grading and paving Hayward street. BOARD OF IMPROVEMENTS, 7 City Hall, September 30.

Fort Riley, Kan.—Grading parade ground. Capt. GEO. E. POND. October 12.

Bridges.—*Goliad, Tex.*—140-ft. span, with approaches and foundations. JAS. A. BURKE, County Clerk. Oct. 20.

Fond Du Lac, Wis.—60-ft. span; superstructure only. E. DELANEY, City Clerk. October 3.

Pottsville, Pa.—In Tremont Borough; 35-ft. span. JOHN LEAHY, Commissioner. October 10.

Lincoln, Neb.—Two bridges, one 80-ft. span. O. C. BELL, County Clerk. October 15.

City Contracts—Street Work.—*Cincinnati, O.* The following bids for paving were recently received by H. J. STANLEY, City Engineer:

Main street, from Fourth to S. Court, (asphalt). Warren Scharf Asphalt Paving Co., $38,667.00. Vine street, Water to Pearl, (granite). F. Kirchner & Co., $23,046.30; Folz Ashman & Co., $23,996.65; J. O'Brien, $25,022.80; J. E. Holmes, $24,336.20.

Main street from North Court to 191 ft. north of Liberty, (granite). J. O'Brien, $55,393.50; G. Everman & Co., $55,143; F. Kirchner & Co.; $53,397; Folz Ashman & Co., $56,009.20; J. E. Holmes, $55,626.70.

Walnut from 4th to Court, (asphalt). Warren Scharf Asphalt Paving Co., $41,494.

Central avenue, Water to Third, (granite). F. Kirchner & Co., $23,153.64; Folz Ashman & Co., $23,838.26; J. O'Brien, $24,110.68; J. E. Holmes, $24,596 22.

Eighth street from Central avenue to Elm, (asphalt.) Warren Scharf Asphalt Paving Co., $14,139.30.

Little Rock, Ark.—About eleven blocks on West Markham street are to be paved with Telford macadam. FRED J. H. RICKON is City Engineer.

Philadelphia, Pa.—A contract for asphalt paving at the Ninth Ward Gas Works has been awarded to the Vulcanite Paving Company at $2.25 per sq. yd.

Rochester, N. Y.—The following proposals have been received for street work:

Jones Avenue Gravel Improvement—Estimate, $4,500.

	5,960 lin. ft. grav. roadway 29 ft. wide.	1,360 lin. ft. curb-stone, new.	1,360 lin. ft. paving and flag-gutter, new, 3 ft. wide	110 sq. ft. cross-walk flagging, 3 ft. wide.	70 lin. ft. stone cross-walk new, 11 ft. wide	50 lin. ft. cross-walk re-laid.	490 lin. ft. main sewer pipe, 12 ins.	3 surface sew. new, without trap, complete, each.	1 surface sew. repaired, without trap, complete.	1 Y-branch in pipe sewer, complete.	11 lot laterals, new, complete, each.	3 manholes, new, complete, each.	Amount of propos
N. L. Brayer	$1.68	$0.48	$0.80	$0.40	$3.50	$1.00	$1.45	$17	$ 8	$1.50	$7.00	$38	$3,982.60
F. C. Lauer's Sons	2.20	43	81	50	3.50	1.50	1.00	20	12	1.50	8.00	40	4,064.90
John McConnell	2.27	45	85	41	3.50	1.00	1.25	25	15	3.00	12.00	45	4,351.80
Wm. Dyer	2.29	45	80	45	3.50	1.00	1.50	25	10	3.00	10.00	50	4,409.90
George Chambers	2.39	44	83	39	3.25	1.00	1.40	20	8	1.20	8.00	35	4,334.20
Whitmore, Rauber and Vicinus	2.47	45	82	45	3.25	93	1.10	24	14	1.00	6.50	34	4,233.40
W. H. Jones & Sons	2.50	45	80	40	3.25	1.50	1.00	25	15	3.50	10.00	40	4,260.00

Awarded to N. L. Brayer.

Mt. Hope Avenue Gravel Improvement—Estimate, $12,360.

	2,200 lin. ft. gravel roadway 24 ft. wide.	4,450 lin. ft. curb-stone, new.	4,450 lin. ft. gutter, new, 3 ft. wide.	330 lin. ft. cross walk, new, 11 ft. wide.	2 surface sewers, new, without trap, complete.	Amount of proposal.
W. H. Jones & Sons	$1.35	$0.45	$0.80	$3.25	$25.00	$ 9,655.00
Wm. Dyer	1.89	0.45	0.80	3.25	20.00	10,833.00
Geo. Chambers	1.91	0.44	0.75	3.50	8.00	10,668.50
N. L. Brayer	1.98	0.50	0.80	4.00	20 00	11,501.00
Whitmore, Rauber & Vicinus	2.25	0.45	0.82	3.25	25.00	11,724.00

Awarded to W. H. Jones & Sons.

Buildings.—*New York City.*—Flooring, etc. at Bellevue Hospital. DEPARTMENT PUBLIC CHARITIES AND CORRECTION, 66 Third avenue. September 30. *Also:* Iron work on armory building. THE ARMORY BOARD, Mayor's office, City Hall. September 29.

Carson City, Nev.—Labor and materials for U. S. Court House, Post Office, etc. WILL A. FRERET, Supervising Architect, Washington, D. C. October 11.

Chelsea, Mass.—Heating apparatus and alterations at U. S. Marine hospital. *The above.* September 30.

Oxford, Miss.—Plumbing, etc., on U. S. Court House. *The above.* September 30.

Birmingham, Ala.—School Building, 108 × 76, three stories. A. O. LANE, Chairman Building Committee. October 18.

Hamilton, Ont.—City Hall. Alderman KENRICK, Chairman Committee. September 30.

Ypsilanti, Mich.—Additions to State Normal School building. S. S. BABCOCK, Treasurer State Board of Education, 34 Buhl Block, Detroit.

Wharf Repairs.—At St. Helena, opposite Norfolk, Va. BUREAU OF YARDS AND DOCKS, Navy Department, Washington, D. C. September 29.

Hydraulic Elevator.—At Army and Navy General Hospital, Hot Springs, Ark. Captain CHAS. H. INGALLS Hot Springs, Ark. October 5.

Contracting.

Fast Tunnelling on the Montana Central R. R.—The following report has been received of the work on the Wickes Tunnel for the week ending September 7

"The progress made this week on the North End is 41 ft. of heading, and on the South End is 48 ft. of heading and 38 ft. of bench. This is the best work done since is starting, and considering the size of the tunnel which is 21 ft. x 16 ft. inside of timbers, we think it creditable showing. If we would not have to timber we could make 60 ft. per week.

"The Ingersoll Drills and Air Compressors are working splendidly on both ends of the Tunnel."

Monroe Avenue Asphalt Improvement—Estimate, $54,000.

	Henry Bolze.	Henry Bolze.	Warren Scharf Asphalt Paving Co.
200 sq. yds. Medina roadway pavement, per sq. yd.	$2.00	$2.00	$1.90
15,358 sq. yds. asphalt roadway pavement, 30 ft. wide, per sq. yd.	2.75	2.82	2.75
10,000 lin. ft. curb-stone, new, per lin. ft.	.32	.32	.35
400 lin. ft. flag cross-walk, new, 8 ft. wide, per lin. ft.	3.00	3.00	2.50
400 lin. ft. main sewer pipe, 12 in., per lin. ft.	.63	.63	.70
6 surface sewers, new, without trap, complete, each	20.00	20.00	20.00
6 surface sewers repaired, without trap, complete, each	8.00	8.00	12.00
100 water service pipes, with fixtures, north side, complete, each	10.00	10.00	8.00
100 water service pipes, with fixtures, south side, complete, each	13.00	13.00	12.00
Total	$49,754 50	$50,029,56	$49,586.50

Awarded to Warren-Scharf Asphalt Paving Co.

Levee Work.—The Board of Mississippi Levee Commissioners awarded the following contracts on Sept. 12 at Greenville, Miss.

Longwood Levee, 500,000 yds., to Geo. Arnold & Co., of Memphis, at 23¾ cts.

Mound Landing Levee, 100,000 yds., to W. E. Ringo & Co., of Mississippi, at 14¾ cts.

Argyle Levee, 90,000 yds. to C. Howard & Son, of Pittsburg, Indiana, at 13¾ cts.

At Delta, La., Sept. 12, the Fifth Louisiana District

Levee Board awarded the following contracts:

Bunche's Bend, 10,000 cu. yds., to Geo. Arnold & Co., at 24½ cts.

Allright, 35,000 cu. yds.; Elton, 44,000 cu. yds., and Lake Providence, 29,000 yds., each at 20 cts.

Bass, 20,000 yds. to T. Byrnes, at 28½ cts.

Illawara, 24 000 yds. to A. J. Scott, at 20 cts.

Reid's, 217,000 yds., to A. J. Scott, at 22 cts.

Diamond Island, 310,000 yds., was not let.

Buck Ridge, 53,500 yds., to A. P. Martin, at 17¾ cts.

Lake Concordia, 150,000 yds., to A. P. Martin, at 17½ cts.

Mor>, 20,000 yds., was not let.

Roseland, 58,500 yds., to A. G. Ober, at 14½ cts.

From Sept. 1, 1886, to Sept. 1, 1887, fifty-four contracts were let by the State of Louisiana for levee-work. The aggregate amount was 1,685,008 cu. yds., and the aggregate contract price was $296,810.73. This is an average per cu. yd. of about 17½ cents.

Sewer Contracts.—*Yonkers, N. Y.*—The contract for building a sewer on Warburton avenue has been awarded to J. & G. Stewart. The sewer is of brick, oval cross-section, dimensions, 42 ins. by 66 ins.; 3,075 ft. in length. The outlet is a 48-in. cast-iron pipe, 125 ft. in length and laid with the remarkably steep grade of 75 ft. in 100. The contract price for the whole work was $33,400. A considerable amount of other sewerage work is to be undertaken by the city of Yonkers at an early date.

Toronto, Ont.—Contracts have been recently awarded for the construction of sewers of a total cost of $67,136. The City Engineer has recommended a considerable amount of further extension which will probably be undertaken at an early date.

Water Works Contracts.—*Sycamore, Ill.*—The contract for the Stand Tower and pipe has been awarded to the Shickle, Harrison & Howard Iron Co., of St. Louis. The remaining portion of the work has been readvertised.

Seymour, Ind.—Bids have been received for the establishment of a system of water-works, the franchise to run 30 years, as follows: American Water Works & Guarantee Company, of McKeesport, Pa., 8 miles of mains, 100 hydrants; annual rental, $3800. Seymour Water Works Company, 9 miles of mains, 85 hydrants; annual rental $4250.

Lockport, N. Y.—The city has awarded the contract for a three million gallon pumping engine to the Holly Company. They have also contracted with the Lockport Hydraulic Company for the use of water for ten years at $1500 annual rental.

Detroit, Mich.—The Murdock Valve Company has been awarded the contract for the corporation stops required for the ensuing year at fifty cents for ¾ in. stops and eighty-five cents for 1 in. stops.

Portland, Ore.—The contract for 1997 tons cast iron water pipe has been awarded to the Oregon Iron & Steel Company at $42.50 per ton. The contract for specials was given to R. Collier & Company, of Portland at 3¼ cents per pound.

Montreal, P. Q.—Tenders have been opened for pumping engine at Station No. 2. H. Dufour, $20,700; H. Bourgeon & Sons, $19,600; R. Wilson, $17,990; Boisineau & Rheaume, $17,500; St. Louis Bros., $16,989.

The contract was awarded to St. Lou's Brothers.

Bridges.—*Chicago, Ill.*—The following proposals were received for building a viaduct 790 ft. long, carrying the street over the tracks of the Western Indiana and Chicago & Alton railroads: Pittsburg Bridge Company, $87,100; Keystone Bridge Company, $83,300; Detroit Bridge & Iron Works, $95,000; A. Gottlieb & Co., $84,600; King Iron Bridge Manufacturing Company, $105,443.

Buffalo, N. Y.—Canal bridge contracts have been awarded as follows: Over Austin street, to McLean & Rockwell, of Syracuse, $4,224.50; over Hudson street, to D. W. McConnell, of Buffalo, $6,663.

Chattanooga, Tenn.—The Decatur Bridge & Iron Works have been awarde l the contract for the bridge across the Tennessee river at the foot of Market street. The bridge with approaches will be 2,490 ft. in length. The work is to be completed within one year.

Buildings.—*San Francisco, Cal.*—The contract for the completion of the Hall of Records of the City Hall building has been awarded to M. J. Kelley at $95,990, he being the lowest bidder. The $140,000 remaining of the present year's fund will be used in interior work on the Larkin street wing. Next year it is expected to complete the main tower, designs for which are now in preparation.

Birmingham, Ala.—The contract for the new Court House has been let to Chas. E. Pierce, of Indianapolis at $179,900.

Chadron, Neb.—The contract for the new Court House has been awarded to J. V. Cousand of Lincoln, for $28,500.

Fort Riley, Kan.—G. D. Huilinger & Co., of Springfield, Ill., have received the contract for constructing the new buildings at the Government post. Their bid was $134,998, about $21,000 less than the next lowest proposal.

Chenango Canal.—Proposals were opened at Utica, N. Y., by the Chenango Canal Commission for excavating 30,000 cu. yds. of earth, building 50 cu. yds. of rubble masonry, furnishing 16 tons of iron pipe and clearing the rises and obstructions. The bids were as follows: Jacob Siegrist, excavation, 21 cts., $6,300; masonry, $3,75, $187,50; clearing, $600; iron p'pe, $54, $864. Total, $7,-951.50. John B. Doyle, excavating, 24¾ cts., $7,425; masonry, $4, $200; clearing, $100; iron pipe, $65, $710. Total, $8,435. J. H. Ehrhardt, excavation, 25 cts., $7,500; masonry, $4, $200; clearing, $300; iron pipe, $50, $800. Total, $8,900. J. J. Dwyer and Thomas Wheeler, excavation, 19 cts., $5,700; masonry, $4, $200; clearing, $150; iron pipe, $35, $560. Total, $6,610. J. White, excavation, 19 cts., $5,700; masonry, $50; clearing, $265; iron pipe, $40, $640. Total, $6,655. The bid of Messrs. Dwyer and Wheeler was accepted.

Bridges, Canals and Etc.

Sault Ste. Marie Canal.—Tenders are to be received by the Department of Railways and Canals at Ottawa, Ont., about January next for the proposed canal on the Canadian side of the Saint Mary's River. The most favorable time for examining the locality will be prior to November 1, and contractors are desired to visit the site of the proposed work and be ready to examine intelligently the plans, specifications, etc., which are now in preparation.

Merchants's Terminal Bridge.—The projectors of this St. Louis enterprise are still negotiating with the railway companies which propose to make use of the bridge. The surveys for the site are in progress under direction of Messrs. MORRISON & CORTHELL, and it is stated that the contract for the construction will be awarded soon. S. W. COBB is President of the company.

New Bridges.—*Newark, N. J.*—A movement is on foot to secure the construction of a bridge from some point in the Eighth ward, near the foot of Fourth avenue, across the Passaic river to Kearny. N. J. DEMAREST is interested.

Chicago, Ill.—The Madison street bridge is to be put under contract at once. It is to be a two-arm, double-roadway, steel, steam, center-swinging bridge, the center pier being at the west side of the river and the bridge swinging clear over the railroads now spanned by a viaduct. The bridge is to be 310 ft. long, 60 ft. wide, and its estimated cost is $200,000.

Fond Du Lac, Wis.—Two bridges are to be built by the city.

Omaha, Neb.—The collection of the special tax, voted in aid of the Council Bluffs & Omaha Highway & Bridge Company last November, is contested on the grounds that the company have as yet done nothing toward the construction of the bridge, whereas by their agreement they were to have the work completed by the time the tax levy was made.

Goliad, Tex.—An iron bridge is to be built across the San Antonio river. Proposals close Oct. 20.

Pennsylvania R. R.—It is stated that a project is under consideration for a bridge across the Ohio river below Pittsburg, to connect the Pittsburg, Cincinnati & St. Louis and Fort Wayne railroads. The proposed location is across Brunot's Island. The river at this point is about 3,500 ft. from bank to bank, and the entire length of bridge and approaches would be nearly a mile. The estimate of cost is put at one and one-half million dollars.

Irrigation Work.—At Lodi, Cal., work is to begin at once on the dam and 30 foot canal of the Mokelumne Ditch & Irrigation Company.

Water Power.—*Sault Ste. Marie, Mich.*—The Sault Edison Light & Motor company has let the contract to Minor & Hodge to build a canal 20 × 10, and 2,400 ft. long from the head of the rapids along the river front, to be completed within sixty days. The head of water is 10¼ ft.

Rapid Transit.—*Rochester, N. Y.*—The sale of the franchise for the cable railway was delayed by an injunction and will take place October 8.

Kansas City, Mo.—The Fifteenth street cable line has been opened for traffic.——The Kansas City & Suburban Railroad Company has been granted a franchise for the portion of the line on Second street.

Portland, Ore.—The Portland Cable Railway Company have their line under construction and intend to complete nearly three miles this year. J. C. MCCAFFREY is President.

Chattanooga, Tenn.—The Mission Ridge road is reported complete and in operation.

Minneapolis, Minn.—The Continental Cable & Street Car Company has been incorporated to build cable and other railways in the United States, Canada and Mexico. HORACE P. BREED of Minneapolis is one of the incorporators.

Livermore, Cal.—J. W. SELIGMAN of New York City and others have been granted a charter to construct a system of street railways to be operated by steam or otherwise.

Woodland, Cal.—O. I. CHENEY is endeavoring to secure a franchise for an electric railway one mile in length.

St. Joseph, Mo.—Work is in progress on the Circle Cable Railway Company's road. It is to be six miles in length.

Pittsburg, Pa.—The Oakland & Homestead Cable Road Company will be chartered to build a road to the suburb of Squirrel Hill.

Denver, Col.—The electric railroad to the Colfax Avenue suburb is not running at present. Repairs are in progress, however, which it is expected will obviate the difficulties formerly experienced.

St. Paul & Minneapolis Rapid Transit Company.—This is a scheme for an elevated electric railroad between the cities of St. Paul and Minneapolis. The company now has under construction an electric surface line in South St. Paul, the cost of which will be about $45,000 per mile. The cost of the elevated line is estimated at $90,000 to $125,000 per mile, and the total cost of the whole structure and equipment at from one to one and one-half million dollars. The route of the line will probably be between the Chicago, Milwaukee & St. Paul and Manitoba Railways. The incorporators of the company are P. B. L. Hardenbergh, Charles W. Hackett, William Lindeke, James P. Moore and Gustav Williams, St. Paul; Charles R. Chute, Samuel C. Gale, W. W. Huntington and Anthony Kelly of Minneapolis.

Street Railways.—*Sacramento, Cal.*—Lewis & Alsip have been granted a franchise for the J. and N. Street road. F. D. Meyer has applied for a franchise for a line on Twenty-fourth street, the line to be built in 60 days.

Omaha, Neb.—The City Suburban Transit Company has been incorporated with a capital stock of $50,000. F. O. GLEASON is President, and C. H. SHEAFE, is Secretary.

Chattanooga, Tenn.—Considerable extensions are in progress. J. H. WARNER is President of the Company.

Quincy, Mass.—Stock has been subscribed for a street railway, 4½ miles in length. The use of electricity as a motive power is being discussed.

RAILROADS.

East of Chicago.

Existing Roads.—*Detroit, Charlevoix & Escanaba.*—Grading is to begin very soon on the division of this Michigan road between Kalkaska and Petoskey. The division extending from Petoskey to the Mackinaw Straits is now being located.

Montreal & Western.—This Canadian line is now under contract from St. Jerome to Chute aux Ircquois, a distance of 70 miles. Right of way has been secured for the first thirty miles and ground will be broken within a few days. It is expected to push the work so that 10 or 15 miles of track can be laid before winter. E. RODIER, 45 Jacques Cartier Square, Montreal, is Secretary and Treasurer, H. J. BEEMER, is Chief Contractor.

Great Eastern.—On this Canadian line track has been laid since Jan. 1, from Yamaska to St. Francis, 6½ miles. Work is in progress from St. Francis to St. Gregoire, 23½ miles, and it is proposed to begin work at an early date on the extensions from St. Gregoire to Levis, about 75 miles, and from Yamaska to Contrecoeur, 20 miles. Work has begun on the foundations of the bridge across the Nicolet river, which is to be 1300 ft. in length; and the St. Francis bridge, 2400 ft. long, and the bridge across the Richelieu, 1200 ft. long are being located. C. N. ARMSTRONG, of Montreal is the contractor for the whole work.

Baie des Chaleurs.—During the present year, track has been laid on this Canadian road from Metapedia to Nouvelle, 26 miles, and construction is in progress from Metapedia to Paspebiac, 100 miles. Surveys are in progress for the extension from Paspebiac to Gaspé, 80 miles, and it will probably be put under construction at an early date. The principal bridges on the line are over the Cascapedia and Bonaventure rivers. C. N. ARMSTRONG, of Montreal, is contractor for the whole work.

Canadian Pacific.—A recent rumor states that the Ontario & Quebec Ry., Detroit extension, from London to Detroit, for which surveys were made last year, is to be put under contract at at early date, the extension will be 110 miles in length.

Cincinnati, Jackson & Mackinaw.—Jackson, Mich., will raise $75,000 to secure the extension from Cecil, O., to that point.

Fairchance & State Line.—It is reported that work has begun on this line running from Fairchance in Southwestern Pennsylvania to a connection with the Baltimore & Ohio, near the West Virginia State Line. I. N. RICHARDSON, 111 Fourth avenue, Pittsburg, is Secretary.

Toledo, St. Louis & Kansas City.—There seems to be little doubt that with the completion of the work of changing the gauge, the proposed extension from Frankfort to Indianapolis will be undertaken.

Lehigh Valley.—It is stated that work is to be pushed at once on a ten mile line from New Brooklyn to the Central R. R., of New Jersey, at Roselle.

Cleveland & Canton.—It is stated that the extension from Bowerston to Wheeling will be undertaken by the Cleveland & Wheeling Co., and that bonds for constructing and equipping the line will be placed on the market at once.

Chicago & Northwestern.—R. B. Langdon & Co. have 1,200 men at work on the extension from Ishpeming to Champion. Grading will be completed by November, and the line will be in operation by the end of the year.

Morris County.—This line, which was built last year, extending from Port Oram, N. J., to Charlotteburg, 12 miles, is to be opened for business at once by the Central R. R., of New Jersey.

Louisville, New Albany & Chicago.—A corps of surveyors are working on the proposed extension from Bainbridge to Brazil, Ind., and thence to Terre Haute. It is also stated that the Orleans, Paoli & French Lick branch will be extended 30 miles to Jasper as was originally contemplated.

Wabash, St. Louis & Pacific.—It is stated that work will begin at once on a line from Mexico to Peru, Ind., 4 miles in length.

New York & Harlem.—The work of lowering the tracks of this road in the 23rd and 24th wards of New York City is to be undertaken at an early date. The maximum depression will be about 7½ ft. Street bridges will be required at 21 streets. The map showing the contemplated changes is now on file in the office of the New York Park Commissioners.

Cincinnati, Wabash & Michigan.—It is said that construction on the extension from Anderson to Rushville, Ind., will begin about the middle of October. Right of way is nearly secured.

Pennsylvania.—Work is in progress on the Harsimus Cove terminus at Jersey City and about $150,000 will be expended this fall. It is reported that surveys are in progress for a line to Red Bank, Long Branch and southern New Jersey, independent of the Central of New Jersey.

New Projects and Surveys.—*Ontario Pacific.*—This Canadian line is projected from Cornwall to Perth, with a branch from Russell to Ottawa. A vote is to be taken soon by Cornwall on granting a subsidy of $35,000 to the company.

Chiticoumi & Lake St. John.—It is proposed to extend this line, which has a government subsidy of $96,000, beyond Roberval to the Lake Edward junction.

Baltimore & Eastern Shore.—This Maryland project is endeavoring to secure aid from Wicomico County.

Rumford Falls & Buckfield.—The survey of this Maine road is in progress. PARKER SPOFFORD is Chief Engineer.

New York, Danbury & Boston.—It was stated at the recent annual meeting that a syndicate is forming which is to take hold of the project and push it to completion. The line is to run from a connection with the Suburban Rapid Transit road to Danbury, Conn. This company is the successor to the Ridgefield & New York and other companies now defunct, that have, however, left some partially graded road bed which will be utilized. It is questioned whether this scheme may not be pushed as a New York entrance for the New York & New England road.

Oneonta & Otego Valley.—This company has been incorporated by A. W. SOPER, 160 Broadway, New York, and other of the projectors of the Mohawk and Susquehanna Valley R. R., to build a line from Otsego to Oneonta, about 28 miles.

Bound Brook & South Amboy.—A line has been surveyed between these points in New Jersey. Hon. D. C. CHASE is interested.

Sandusky, Norwalk, Ashland & Coshocton.—This is a projected Ohio road, of which the route is indicated by the above title. The usual "New York syndicate" is reported back of the project and it is stated that they have ordered surveys made at once.

Southern.

Existing Roads.—*Atlantic & Danville.*—The company has executed a mortgage to the Mercantile Trust Company, of New York City to secure bonds to be issued at the rate of $16,000 per mile on the whole road now built and under construction. The road is to run from Danville to Hicksford, 140 miles, Hicksford to Portsmouth, 60 miles, and Claremont to Hicksford, 54 miles. A branch from Suffolk to Goldsborough, N. C., is also contemplated.

Nashville, Chattanooga & St Louis.—The annual report of this company states that the branch from Huntsville, Ala., to Elora, Tenn., 27 miles, will be in operation within 30 days. The Jasper branch has been extended to the Whitewell mines, 4 miles, and the extension of the McMinnville branch to Bon Air, 7 miles, will be completed by Jan. 1. Surveys have been made for an 18 mile extension of the Centreville branch and it is proposed to construct it at an early date.

Savannah, Florida & Western.—The final location of the extension from Thomasville, Ga., to Tallahassee and Monticello, Fla., is completed and proposals for grading the northern section of ten miles are called for as noted last week in "Proposals Open."

Kansas City, Memphis & Birmingham.—The tracklayers have completed the work on this extension of the Fort Scott & Gulf system. The line extends from Memphis, Tenn., to Birmingham, Ala., a distance of 251 miles.

Marietta & North Georgia.—Notwithstanding the defeat of the bill allowing the company to build the extension from Marietta to Atlanta, it is stated that the extension will be built under the general railroad laws. As the northern extension seems well assured, the future termini of the road will be Atlanta and Knoxville.

East Tennessee, Virginia & Georgia.—Contracts have been let for the construction of the 15-mile extension from Emory Gap to Clinton, Tenn.

Blue Springs, Orange City & Atlantic.—The extension from the St. John's river to Tavares is under survey.

Gulf & Ship Island.—Grading is making good progress on the southern division. The surveys for the location of the piers at Mississippi City, the Gulf terminus, are in progress.

Buena, Vista & Ellaville.—Grading is completed on the extension from La Crosse to Americus, Ga., and tracklaying has begun.

South Florida.—Grading is finished on the Brushy Point extension.

Orange Belt.—The financial troubles of this road are reported adjusted, and tracklaying is to be pushed at once.

New Projects and Surveys.—*Paducah, Chickasaw & Birmingham.*—This company has been incorporated in Alabama and proposes to build a railway from Chickasaw, Colbert county, *via* Russellville to Birmingham. G. T. MCWHORTER is interested.

Eastern Barnwell & Western.—This company is to be incorporated in South Carolina by W. H. DUNCAN and others. The line is to run from Columbia S. C., to Savannah, Ga., and is now under survey. A branch from Hardeeville to Augusta is contemplated.

Birmingham, Mobile & Navy Cove Harbor.—The representatives of this Alabama project have been trying to raise funds in Chicago. Gen. MCNULTA, Receiver of the Wabash, is President of the company.

Carolina, Knoxville & Western.—This Tennessee company has now absorbed the Atlantic, Greenville & Western and the Transylvania & Haywood Companies. W. L. MAULDIN, Greenville, S. C., is President. Counties along the proposed line are voting subsidies and the company seems in a fair way to carry through its projected lines.

Jacksonville & Mandarin.—Incorporated at Jacksonville, Fla., by J. J. DANIEL and others.

The Northwest.

Existing Roads.—*Jacksonville Southeastern.* Grading is about finished on the 20-mile extension from Centralia, Ill., to Driver's Station, and tracklaying has begun.

St. Paul, Minneapolis & Manitoba.—Grading will be finished on the line from Watertown to Huron, Dak., by Nov. 1. The line has been located from Huron to Woonsocket. Tracklaying is in progress on the Moorhead & Southeastern line.——New York stock brokers are rather jealous of the phenomenal progress of the Manitoba and the Atchison, because very little of the ownership or control of these enterprising companies is held by New York parties or comes within the reach of the Stock Exchange manipulators. The following extract from the New York *Times'* Wall Street news shows pretty well this spirit: "Manitoba is one of the inactive stocks of this market, principally because it is held in large blocks by a few holders and has never been disturbed. Its last quoted price was 114. The other day some one went to sell a few shares, and the best bid obtainable was 108. If there had been any more for sale it might have gone to par. Some day the distribution of the stock will be made and it will not be distributed at par. The Manitoba Company is building itself to death."

Red River Valley.—The injunction case now being tried at Ottawa seems likely to result favorably for the Manitobans, the Chief-Justice holding that the Province had a right to construct the road under the Public Works act. It is also argued that the Disallowance measure of the Dominion government was not legally made. Rails enough to lay half the road have been shipped from Montreal, Premier NORQUAY was doubtless unsuccessful in his efforts to raise funds in New York owing to the tight money scare, but he is reported to have concluded satisfactory negotiations with foreign parties for sale of the Provincial bonds.

Duluth, South Shore & Atlantic.—There was a celebration at Sault Ste. Marie over the completion of the line from Sage, Mich., to that place, a distance of 60 miles, this being the first road to reach this future railway center. Work is making satisfactory progress on the great bridge at this point. All the piers but one are built and the approaches on the Canadian side are completed. It is now stated that an alliance is probable between the Duluth, South Shore & Atlantic and the Burlington system.

Chicago, Burlington & Quincy.—A preliminary survey has been made for a line from Beardstown, Ill., to Camp Point, on the Quincy branch. This revives the rumor of a probable lease of the Ohio & Mississippi's Springfield division to the Burlington.

Minnesota & Northwestern.—The Central Iowa Company is being reorganized in this interest.

Winnipeg & Hudson Bay.—Of the condition of this Manitoba enterprise much is rumored and little is known; but we can now definitely report progress as follows: Track has been laid this year from Winnipeg to Lake Manitoba, a distance of 40 miles and the line is under contract from that point to Port Nelson, Hudson Bay, 610 miles. A branch is projected from Lake Manitoba to the Saskatchewan river, a distance of 200 miles. HUGH SUTHERLAND, of Winnipeg, is President of the Company.

Minneapolis, Sault Ste. Marie & Atlantic.—The tracklaying has been completed on the gap from Minneapolis to Turtle Lake and trains are now running from Minneapolis to Gagen, Wis., a distance of 231 miles.

Pacific Ry. in Nebraska.—This line from Warwick, Kan., to Hastings, Neb., the ownership of which by the Missouri Pacific, the officials of that company have persistently denied, is to be pushed to completion at once and is now definitely stated to be a part of the Gould system.

The Southwest.

Existing Roads.—*St. Louis, Arkansas & Texas.*—The location of the extension from Malden to Grand Tower, Mo., where the Mississippi river is to be bridged, has been completed by the Division Engineer, SILAS C. MARTIN. The right of way for the Fort Worth extension has finally been obtained and grading is in progress all along the line.

Marshall, Paris & Northwestern.—Bonds are to be issued by the company for carrying on the construction of the line.

Atchison, Topeka & Sante Fé.—On the Mulvane extension, track has been laid to Ashland, Kan.

Texarkana Northern.—Track on this road was laid last year from Texarkana, Ark., to the Red river. President Hinckley of the St. Louis, Kansas City & Colorado, who has agreed to complete the line to Fort Smith, Ark., is now pushing the locating surveys.

Fort Worth & Rio Grande.—The locating survey has been finished from the present terminus at Granbury to Coleman, Tex., about 100 miles.

New Projects and Surveys.—*Montana Kansas & Texas.*—In reference to our item of two weeks ago concerning this airy project, a correspondent writes: "For 'Stanburg,' Mo., read 'Stanberry.' A town laid out in '79; particularly "mushroomy" in its earlier stages and well adapted for the residence of promotors of mushroom railroad projects. Apparently nothing less than a 1500 mile system would suit the aspiration of the enterprising residents of that gay and festive 'burg.'"

Summit & Clifton.—THOS. WARDELL, of Summit, Mo., is interested in the construction of a proposed railway from Summit to Clifton or Salisbury on the Wabash Western Ry., a distance of 32 miles.

New Orleans, Natchez & Ft. Scott.—President JOHN H. RICE is still busy securing subsidies for the line in Arkansas and Louisiana. It is confidently affirmed that work will begin November 1.

Rocky Mountain and Pacific.

Existing Roads.—*Northern Pacific.*—An open rupture has finally occurred between the working parties on the Spokane & Palouse line and the Oregon Railway and Navigation Company's road. A party of employees of the former company went on Sunday morning and tore up the track of the latter near Garfield, W. T., and put in a crossing for their own line.——There are an abundance of rumors afloat concerning a probable pooling of interests of this company with the Union Pacific. There seems little doubt that it is to enter Chicago over the Wisconsin Central and it is stated that if arrangements can be made for the use of the Chicago terminals, the Union Pacific will push a line from Omaha east to Chicago at once.

Oregon & Washington, Territory.—Grading is about completed on this road extending from Pendleton to Wallula, 60 miles, and tracklaying is being pushed. It is intended to have the whole line in operation by Nov. 15.

Mexican National.—A large number of sub-contracts have been let, and graders are already at work.

Atlantic & Pacific.—An authentic (?) report of the Associated Press states that the company is locating an extension from Mojave to Sacramento, Cal.

New Projects and Surveys.—*Salt Lake City & Los Angeles.* This new project is being boomed at both its termini and large amounts are reported as subscribed.

Peninsular Ry. of Lower California.—This project which is backed up by a heavy subsidy from the Mexican Government is making surveys for its line from San Diego, Cal., to Ensenada.

Corralitos.—A line is reported under survey from Deming, N. M., to Casa Grande, Mexico.